MAC 1100/1200/1200 ST
Servicing Instructions

Version 1.2

227 492 20 ENG INT Revision F

GE Medical Systems
Information Technologies

Caution:
During repairs/service interventions, observe the protective measures against damage due to ESD.

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* This manual contains service information; operating instructions are provided in the operator's manual of the instrument.

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Revision History

Each page of this manual has the document number followed by a revision letter, located at the top of the page. This letter identifies the manual update level. The latest letter of the alphabet corresponds to the most current version of the document.

The revision history of this manual is summarized below.

Date	ECO No	Revision	Remarks
March 05,1999		A	V 1.0, initial release
May 10, 1999	062 136	B	Software Package for MAC 1100/1200 (Software change) page 55, new MRI
June 29, 1999	062727	C	Pin 4 – Coding pin, page 19, Supplementation to chapter 3.4; page 29 Software Release V 5.02 page 55, new MRI, PCB Control CS_CI , Sheet 9 new Index PCB Control CS_C, new Index PCB Battery Charge CS_CI, new Index
February 4, 2000	062920	D	Device Version V1.1 with Remote Start Input, internal Modem Supply (MAC1200 US device only) and Software Release V5.1
February 7, 2001	064323	E	Device Version V1.2 , MAC 1200 ST, Japanese device model , Software Release V5.2
January 9, 2002	068851	F	Software Release V5.21 for MAC1200 and MAC1200 ST

1 Device description

This Service Manual describes device version **V1.2 of MAC1100 / MAC1200** / **1200ST.**

The **MAC1100** is a portable electrocardiograph with an integrated printing unit.
They are used to acquire, record and process ECG signals.

The integrated LCD graphics Display shows 3 ECG channels. It also displays status information, filter settings, speed/format, gain and the status of the electrodes.

With the setup feature, the user is able to setup the device and the modes for his own needs.

The MAC1100 offers 2 modes of operation: Automatic (12-lead) and Manual (6-lead). Transmission of one in the automatic mode aquired ECG to the MUSE or CardioSys system directly or via a modem.

It is designed for line-power operation.
In addition, a NC-battery with a charging circuit can be integrated into the instrument as a separate option.

In addition, a pump for the KISS system can be integrated into the instrument as a separate option.

The patient cable for the acquisition of ECG signals is connected by means of a 15-pin connector as used with MAC 500. Patient cables used with MAC 1000 cannot be connected to the MAC 1200.

The **MAC1200/1200 ST** has all features of the MAC1100, in addition, the following features are included:

- NC battery with charging circuit is integrated in general
- Arrhythmia as third mode of operation
- Automatic mode with CSI protocol for transmission
- Automatic mode with interpretation (Option Code)
- Automatic mode with storage for up to 40 ECGs (Option Code)
  The acquired ECGs can be transmitted to MUSE or CardioSys directly or via a Modem.
  Additionally the MAC 1200 ST can run stress test operating mode (Option Code).
  To control stress test devices the MAC 1200 ST has a modified keyboard with additional keys for stress test.

MAC1100/1200/1200 ST with version **V1.2** has all features of the version V1.0 described above
New in version V1.1: Remote Start Input, internal Modem Power Supply (MAC1200 US device only) , Software V5.1
New in Version 1.2 : MAC 1200 ST with operating mode stress test, Japanese device model, Software Release V5.21. Note: MAC1100 has Software Release V5.2

Variants of the MAC1100/1200

The complete list of the variants is included in **Section 8 "Parts List".**

The following table gives an overview of the different device models of the MAC1100/1200/1200 ST.

Device	Device Model	Manufacturer ID	Keypad	Labeling	Mains Voltage
MAC1100 MAC1200 MAC1200 ST	INT	GE Medical Systems	Icons	International	230V
MAC1100 MAC1200 MAC1200 ST	Europe 2	GE Medical Systems	Text	International	230V
MAC1200 MAC1200 ST	USA	GE Medical Systems	Text	USA	115V
MAC1100 MAC1200	RUSS	GE Medical Systems	Kyrillian	International	230V
MAC1200 ST	Japan	GE Medical Systems	Japanese	International	230V

Hardware functional blocks:

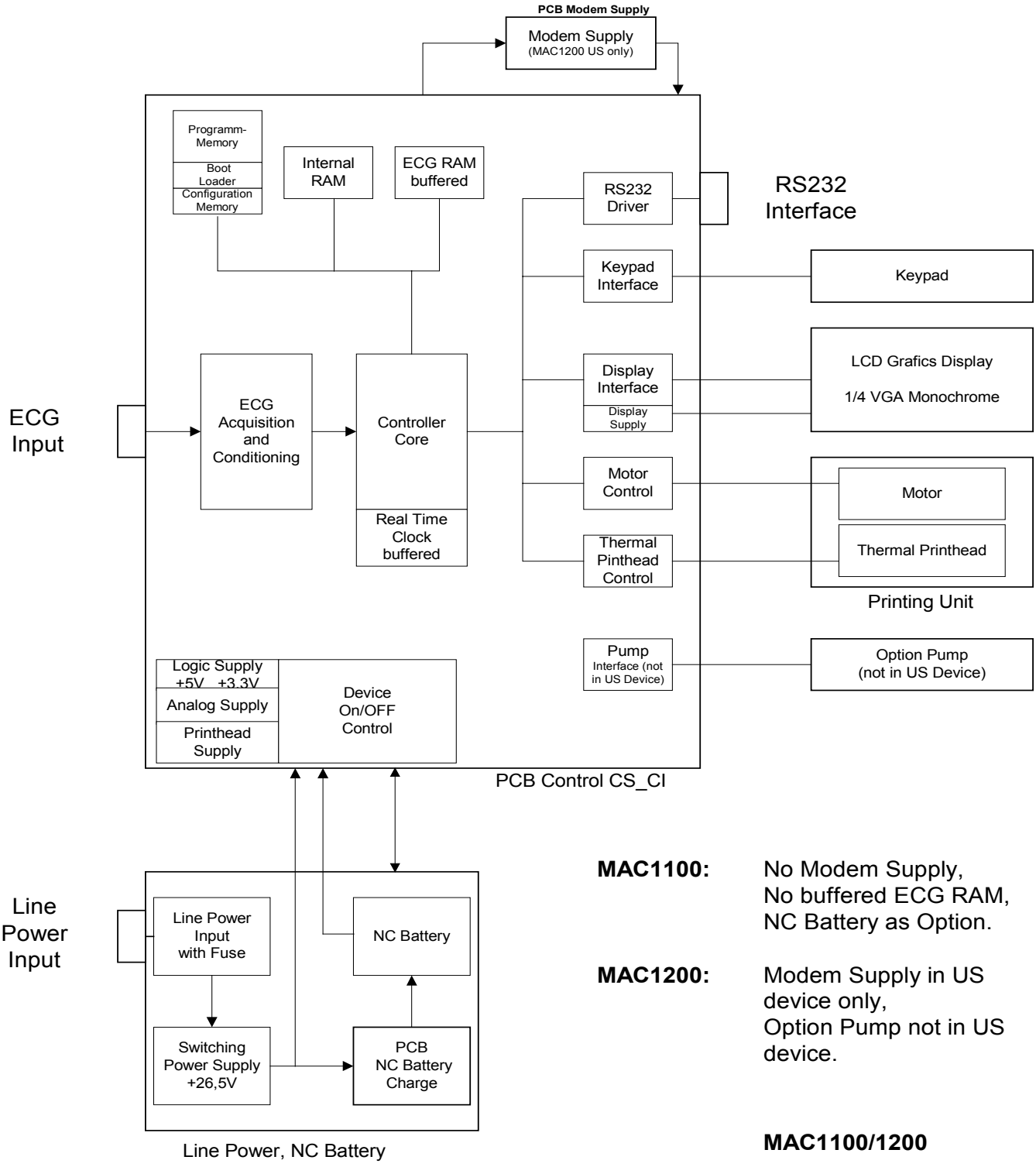
MAC1100 and MAC1200/1200 ST comprises of the same hardware functional blocks. Differences between both are mentioned.
List of the main functional blocks:

- Switching power supply
- NC Battery *for MAC1100 only as an option*
- PCB NC Battery charge *for MAC1100 only as an option*
- PCB Control CS_CI
- PCB Modem Supply CS_M *for MAC1200 US device only, from version V1.1*
- Printing unit
- Keypad
- ¼ VGA graphics display, monochrome

The description of the functional blocks is valid for MAC1100 and MAC1200/1200 ST Differences between MAC1100 and MAC1200 / 1200 ST in single functional blocks are mentioned within the description of such blocks.

1.1 Block circuit diagram of entire instrument

MAC1100/1200 Version V1.1



MAC1100: No Modem Supply,
No buffered ECG RAM,
NC Battery as Option.

MAC1200: Modem Supply in US device only,
Option Pump not in US device.

MAC1100/1200

V 1.1
14.01.2000

1.2 Mechanical components

The main mechanical components comprise the **upper and lower shell** of the **MAC1100/1200.**
The lower shell serves as a basic unit to receive the following assemblies:

- Line power input module with fuse
- Switching power supply
- NC Battery
- PCB NC Battery Charge
- PCB Control CS_CI
- PCB Modem Supply CS_M
- Graphics display
- Thermal printing unit
- Paper container

The upper shell accommodates the keypad, which is connected to the PCB Control CS_CI via a 26-pin connector.

The MAC1100/1200 can be opened by releasing 5 screws at the bottom of the lower shell, opening the paper flap and lifting up the upper shell a little bit to remove the keypad cable from the PCB Control CS_CI. The upper shell then can be removed completely.

To replace the NC Battery, the battery flap at the bottom of the lower shell must first be unlocked with a screw-driver before it can be removed.

The 15-pin input connector to connect the **patient cable** and the 9-pin connector for the **RS-232 interface** are located directly on the PCB Control CS_CI.

2 Functional description

The block circuit diagram of the entire instrument in Section 1.1 and the functional blocks of circuit diagram sheets (P-plans) describe the individual functional blocks.

2.1 Switching power supply

The switching power supply generates the fundamental device voltage for the PCB Control CS_CI and for the PCB NC Battery Charge.

It has the following input specifications:

Input voltage range: 85 ... 264V ac
Line frequency range: 47 ... 65 Hz

The output voltage is +26.5 V dc, the maximum load is 1.5A.

2.2 PCB NC Battery Charge

MAC1200 / 1200 ST and MAC1100 with the option “Battery” can operate battery powered. With a new, fully charged NC battery, in Automatic Mode up to 50 ECG can be recorded.

The PCB NC Battery Charge, controls and monitors the charging process, depending on the status of the battery and the status of the device.

Section 2.2.1 and 2.2.2 is not valid for MAC1100 without option “Battery”.

2.2.1 Charging circuit for the NC battery

An integrated charging device is used to charge the battery. During charging it monitors the battery voltage function and switches over from rapid charging to trickle charging.

Applying the line power to the MAC 1200 / 1200 ST, or insertion of the battery activates the charging circuit.
During a recording, the charging current is reduced.
In standby mode, a depleted battery is fully charged within 4 hours.

2.2.2 Device behavior depending on the state of battery charge

Depending on the status of the battery and the status of the device, the following behavior occurs:

State1: *Battery depleted, line power supply is connected up:*
Battery charged in rapid mode; when fully charged, switchover to trickle charging.

State 2: *Battery full, line power supply is connected up:*
Battery charged in rapid mode for some minutes till the charging circuit recognizes “battery full“, then switchover to trickle charging.

State 3: *Battery depleted, no line power supply, device is switched on:*
Device inoperative.

State 4: *Battery full, no line power supply, device is switched on*:
Device fully operative.
When battery is almost depleded, the LEDBAT signal is activated to Indicate that the device should be charged by connecting to the line power supply. If the operation is continued without line power, MAC 1200/ 1200 ST will shut down itself when a minimum level is reached to prevent the battery from a excessive discharge.

State 5: *Battery depleted, line power supply is connected up, device is switched on:*
Battery is charged in rapid mode, device is fully operative, including recording.
During recording, the charging current is reduced. If in this phase, a lot of recordings take place, the battery is not fully charged within 4 hours.

2.3 PCB Control CS_CI

The PCB Control CS_CI is the mainboard of the MAC 1200 / 1200 ST, the PCB Control CS_C is the mainboard of the MAC1100, which has not all memory circuit mounted. The mainboard accommodates the control functions of the device, except the line power supply and the NC battery-charging controller.

2.3.1 Generation of internal power supplies

Logic power supply + 5V and + 3.3V

The processor core and the memory is a fully + 3.3V design.
The interface functions to display, to RS-232, to the printing unit and to the ECG acquisition unit are supplied with + 5V.

Both the + 3.3V and the + 5V are generated separately by a clock-rated voltage controller. By using the „adjustable version“ of the voltage controller, both supplies are based on the same voltage controller. The output voltage is determined by appropriate dimensioning of the voltage divider at the feedback input of the voltage controller.

Standby supply + 5VSTB and + 3.3VSTB

The standby supply + 5VSTB supplies the ON/OFF Control, the + 3.3VSTB buffers the patient ECG memory when the device is turned off.
Both supplies are generated together from one low-power linear regulator with low quiescent supply current.

Analog supply + 12V

+ 12V is used for the heating control and temperature monitoring of the printing unit, which requires only a current of a few milliamperes.
This supply is generated by a linear regulator with feedback input.

2.3.2 Switch On/Off circuit

The Switch On/Off Circuit consists of the On/Off Control and the Voltage Control.

The **On/Off Control** switches the device on or off by switching the device supplies +UVERS and +USUPPSW.
The On/Off Control is supplied from the + 5VSTB.

Device On Sequence:

The transition from Device Off State, or Standby State when line power is connected to Device On State can only be activated by pressing the On/Off button.

Device Off Sequence:

The transition from Device On State to Device Off State, or Standby State when line power is connected can be achieved as follows:

- pressing the On/Off button
- when the control core activates the signal DEV_OFF,

- when the voltage control applies the signal REG_OFF_, because the battery voltage gets too low during battery operation.

The **Voltage Control** controls the battery voltage during battery operation.

The signal BATT_LEV2 indicates that the battery charge has gone down, and the device should be connected to the line power soon.

The signal BAT_LEV1 indicates that the battery has been discharged almost completely, the device should be connected to the line power immediately, otherwise the device will shut down within few minutes.

If battery discharge is continued without connecting to the line power, the signal REG_OFF_ is activated and the device is switched off.

2.3.3 ECG recording and front-end processing

The patient input is classified as being cardiac floating and is defibrillation-proof.

The patient leads are connected with a 15-pin connector with a special form for the specified and released patient cables for the MAC1100/1200/1200 ST.

The main element of the ECG recording and front-end processing is a set of chips comprising 3 ASICs. Pace detection is realized by a separate circuit.

Every disconnected electrode is detected by a special AC measurement, which allows higher impedance between electrode and patient.

N common-mode compensation ensures suppression of interference, at the same time serving to improve the in-phase suppression of the input electrodes.

To protect patients, the ECG recording and front-end processing are assembled as floating components. Digital signals from and to the controller core are transmitted via opto-electronic couplers. The floating supply +/- 5V is generated by an isolated flyback converter from the + 5V logic power supply.

2.3.4 Controller core

The actual core comprises the Motorola Power PC MPC821, which contains the following integrated components:

- chipselect logic
- DRAM controller
- SCC and SMC for RS-232
- LCD controller
- SPI Interface
- I/O ports
- Real-Time Clock counter register

In addition, the MPC821 contains a JTAG port with test and programming capabilities.

The MPC821 has the following additional power supplies:
- VDDSYN, filtered from the + 3.3V logic supply, for the clock generation.
- KAPWR, generated from the + 3.3V logic supply, or from a battery when device is off, used for buffering the RTC Counter Register.

The **clock generation** for the MPC821 is realized by a quartz oscillator with 32.768KHz. The system clock CLOCKOUT is adjusted with the internal PLL register. The system frequency is 25 MHz.

The **Watchdog /Reset Generation** is implemented separately in an integrated system monitoring chip. It has the following functions:

- Power-up reset for the MPC821 when the device is switched on
- Voltage monitoring of the + 3.3V and + 5V, with reset generation
- Watchdog
- Switchover to battery supply for patient ECG memory when device is switched off
- Signal for access protection for patient ECG memory when device is switched off

The **Reset Configuration** defines startup conditions like boot port size and clock generation source.

Four LEDs indicate the device status in addition:

LED1:	active when a HRESET_ occurs
LED2:	indicator for the logic supply
LED3, LED4:	indicate internal software states

The **control register** comprises device control signals to switch off the device, control battery charging and display control signals.

The **status register** contains information on the device hardware configuration and the state of the battery charge.

2.3.5 Real time clock

With Software V5.2, two options for the real time clock are supported. The software checks for an external real time clock chip (X13 on PWA control). This chip is available with Index G of PWA Control CS_CI and Index F of PWA Control CS_C.
If the external RTC is found, it will be used for the clock function. If not, the internal clock of the MPC821 will be used. The external RTC is more accurate than the internal one. Both clocks are buffered by the voltage KAPWR.

2.3.6 Memory

The complete memory of the MAC1100/1200/1200 ST is located on the PCB Control CS_C(I).
The software of the device can be loaded through the JTAG Port during the production process, or for service purposes with the appropriate programming software through the RS-232 interface.

Program Memory:

Type:	Flash, + 3.3V supply	
Organization:	1 Mbit x32, 4 Mbyte	*MAC1100: 0,5Mbit x32, 2 Mbyte*
Waitstates:	1 Waitstate	

DRAM:

Type:	EDO DRAM, + 3.3V supply
Organization:	1 Mbit x32, 4 Mbyte
Waitstates:	0 Waitstate

Patient ECG Memory:

Type:	buffered SRAM, + 3.3V supply	
Organization:	256 Kbit x16, 512Kbyte	*MAC1100: No patient ECG memory*
Waitstates:	1 Waitstate	

Configuration Memory:

The configuration memory is part of the program memory Flash. With special hardware and software protection facilities, write access to the Flash is only possible in the defined configuration memory of the Flash. Thus an external configuration Memory like an EEPROM is not required.

2.3.7 LCD graphics display interface

For the LCD interface to the ¼ VGA monochrome LCD interface, the internal LCD controller of the MPC821 is used.

Controller Interface:

For the digital control signals, delivered from the MPC821, only an output driver is required.

LCD Power Supply:

The LCD power supply VEE of -23V is generated from the +5V logic supply. The generation starts after HRESET_ becomes inactive to ensure that the logic supply of +5V first is applied to the display.

Adjusting Contrast:

Contrast adjustment of the Display is accomplished with the contrast voltage V0. The level of V0 is controlled with the PWM signal BLCD_CONTR from the timer module of the MPC821. In addition, the contrast voltage is temperature compensated.

Backlight:

The LCD backlight converter for the CCFL tube is located on the PCB Control CS_CI too.
The backlight converter is generated from the +5V logic power supply.
The signal BLCD_ENBA switches the backlight on or off.
The user can define the backlight active time in the configuration menu.

2.3.8 Keypad interface

The keypad interface contains the control register for 8 keypad columns and the receiving register for 7 keypad rows, and the control signals for the status LEDs: LED_LIN, LED_BATT, LED_START and LED_STOP.

Using the matrix of 8 x 7, up to 56 keypads can be detected.

Identification of the key pressed is as follows:
The controller activates a column, activation is via low-level, then the row-register is read to identify the pressed key by a low-level. This procedure is repeated with the next column, till all columns have been activated.

2.3.9 Printhead control

The printhead controller takes on the complete control of the 216-mm thermal printhead with a line width of 200 mm.
The output rate to the printhead is 1000 /sec. The resolution in the Y-direction is 8 dot/mm, in the X- time axis up to 40 dots/mm.

Thermal Printhead Dot Control:

The MPC821 prepares a complete dot column and sends it to the FIFO. A complex PLD reads out a complete column of the FIFO and generates the digital control signals for the printhead, which are shifted in series.

The duration of heating a dot column is defined through the pulse width of the PWM Signal HEAT that is generated from the complex PLD too.
In addition, the duration of heating a dot column is influenced by the thermal printhead monitoring.

Thermal Printhead Temperature Monitoring:

The thermal printhead temperature monitoring measures the temperature of the thermistor, located on the printhead. A constant current source effects a temperature-dependent voltage drop.

If a printhead temperature of 55°C is exceeded, the signal REC_OVHEAT_ is activated and the heating of the printhead is prevented by disabling the signal STROBE.
Only when the printhead temperature drops below 50°C is the signal REC_OVHEAT_ disabled and the heating via the signal STROBE re-enabled.

In addition, a continuous reduction of the heating duration occurs with increasing printhead temperature, resulting in a regular typeface throughout the entire temperature range.

2.3.10 Motor control

Paper transportation for the speeds 5mm/s, 25mm/s and 50mm/s is driven by a stepping motor. The stepping motor is controlled by an integrated stepping motor driver circuit. The current for the motor is adjusted by the sense resistors of the stepping motor driver.

For the speed 5mm/s, the motor current is reduced, triggered by the signal LOW_SPEED.

The motor speed is controlled by the frequency of the signal RECTMR_STEP, which is generated by the timer unit of the MPC821.
The driver circuit is enabled by the signal REC_MOTEN, the driver is powered from +22,5V.

2.3.11 RS-232 interface

The MAC1100/1200/1200 ST has an RS-232 interface accessible with a 9-pin Sub-D connector.
Except for the RS-232 driver chip, the interface is integrated into the control core of the MPC821.

The interface has the following attributes:
- hardware handshake with the signals RTS and CTS
- or software handshake with XON/XOFF
- transmission speeds from 4800 ... 57600 Baud
- maximum input voltage range: +/- 15V
- minimum driver output voltage: +/- 5V
- maximum ESD interface protection: +/- 10kV

From version V1.1, MAC1100/1200 additionally provides a remote start input on the RS-232 interface. The MAC1200 / 1200 ST US device additionally provides a modem power supply output on the RS-232 Interface.

2.3.12 Buzzer

The buzzer is an integrated signal generator with fixed frequency, directly operating from the +5V logic power supply.
Activating and deactivating is controlled with the signal SPEAKER.

2.4 PCB Modem Supply CS_M (only US device, 101 168 23)

PCB Modem Supply CS_M generates a supply voltage of +8V dc, to operate a special GE marquette modem direct on the RS-232 interface on the MAC1200 without the need of an external power supply for the modem.

The Voltage is generated by a switching regulator with current limit and thermal protection from the +26,5V.
The modem supply voltage +8V is accessible on Pin 6 of the RS232 interface.
The protection against ESD is realized with a Transzorb diode on the PCB Control CS_CI

.

2.5 Internal interfaces

2.5.1 Mechanical interfaces

Mechanical interfaces are described in Section “1.2 Mechanical Components“.

2.5.2 Electronic interfaces

This section describes the pinning, function and significance of the signals on the internal interfaces of the functional components.

2.5.2.1 Interface to the switching power supply

The interface to the switching power supply is realized by the connector POSUP/ on the PCB Control CS_CI.

Connector denotation: **POSUP/**

Type: male connector 1 X 4-pin., 180°, AMP MODU I

reverse terminal protection achieved mechanically.

The function of the individual pins is given in the following table . The definition as an input/output is seen with reference to PCB Control CS_CI.

POSUP/

Pin Number	Signal Name	input/output	Function	Definition
1	+24VPS	Input	Voltage from power sup.	+ 26,5V
2	+24VPS	Input	Voltage from power sup.	+ 26,5V
3	GNDPS	Input	GND from power supply	
4	GNDPS	Input	GND from power supply	

2.5.2.2 Interface to the PCB NC battery charge

This interface has the supply for battery charging, charging control and status signals and the battery voltage from the PCB NC battery charge.

Connector denotation: **BATT/**

Type: male multipoint connector 2x 10-pin, 180°

reverse terminal protection and coding with coding pin 15

The function of the individual pins is given in the following table . The definition as an input/output is seen with reference to PCB Control CS_CI.

BATT/

Pin Number	Signal	input/output	Function	Definition
1	+24V	Output	Supply battery charging	
2	+24V	Output	Supply battery charging	
3	+24V	Output	Supply battery charging	
4	Code		Coding Pin	
5	NC			
6	GND24V		common Ground	
7	GND24V		from power supply	
8	GND24V		after ferrite decoupling	
9	GND24V			
10	+UBATT	Input	Battery voltage	
11	+UBATT	Input	Battery voltage	
12	+UBATT	Input	Battery voltage	
13	+UBATT	Input	Battery voltage	
14	+UBATT_ME	Input	Battery measuring output	
15	Code		Coding Pin	
16	+5V_L	Output	+ 5V supply	
17	NC			
18	BATT_OPT_	Input	Status option battery	"0": option active
19	LOAD_OFF	Output	Charging reduction	"1": reduced charging
20	NC			

2.5.2.3 Interface to the LCD Graphics Display

The interface to the LCD graphics display provides the LCD data signals, the display supply voltages +5V and VEE, the display contrast voltage V0 and the display on/off control signal.

Connector denotation: **HOS/**

Type: Foil connector, 14- pin, zero power insertion, 180°

The LCD supply voltage VEE can be measured at R 731 on the PCB Control CS_CI, the LCD contrast voltage can be measured at R 730. Both levels of these voltages depend on the contrast selected.

The voltage supply for the CCFL tube of the display is provided separately via the connector **BL/.**
Caution! Do not touch! High AC voltage!

2.5.2.4 Interface to the keypad

The interface to the keypad is realized with the connector KEYB/. It contains the signals for the keypad rows and columns, the supply and the control signals for the status LEDs of the keypad. The foil connecting cable is part of the keypad itself.

Connector denotation:	**KEYB/**
Type:	Foil connector, 26- pin, zero power insertion, 180°, grid 1.0mm, Molex

2.5.2.5 Interface to the printhead

The control data to the printhead is transferred via the flexible PCB Printhead Connection, plugged into the connector TPC_DAT/ on the PCB Control CS_CI.

Connector denotation:	**TPC_DAT/**
Type:	male connector 1x 20-pin, 180°

Printhead Supply

The printhead is supplied through a 6-pin connection cable, plugged to the connector TPC_PO/ on the PCB Control CS_CI.

Connector denotation:	**TPC_PO/**
Type:	multipoint connector 1 X 6 pin., 180°, reverse terminal protection, MODU II

The function of the individual pins is given in the following table . The definition as an input/output is seen with reference to PCB Control CS_CI.

TPC_PO/

Pin Number	Signal	input/output	Function	Definition
6	COMMON		Supply Voltage +22,5V	
5	GNDITPC		Ground	
4	COMMON		Supply Voltage +22,5V	
3	COMMON		Supply Voltage +22,5V	
2	GNDITPC		Ground	
1	VDD1		Auxiliary Voltage	

2.5.2.6 Interface to the motor

The motor control signals are supplied through a 6-pin connection cable, plugged to the connector MOTOR/ on the PCB Control CS_CI.

Connector denotation: **MOTOR/**

Type: multipoint connector 1 X 6 pin., 180°,
reverse terminal protection, MODU II

2.5.2.7 Interfaces for production tests

Debug Port

The debug port is an interface for developing purposes. With the corresponding tools, the MPC821 can be set to the debug mode, to show internal states.

Connector denotation: **BDM/**

Type: male connector, 2x 5- pin, 180 °

JTAG Port

The JTAG is an interface for the production test of the processor core and the memory. In addition, the Flash memories can be programmed with this interface.

Connector denotation: **JTAG/**

Type: male connector, 2x 5-pin, 180 °, pin 7: coding pin

The function of the individual pins is given in the following table. The definition as an input/output is seen with reference to PCB Control CS_CI.

JTAG/

Pin Number	Signal	input/output	Function	Definition
1	TMS	Input	JTAG Test Mode Select	
2	TRST	Input	Reset for Scan Chain	"0": Reset active
3	TDI	Input	Data In for JTAG Mode	
4	TDO	Output	Data Out for JTAG Mode	
5	TCK	Input	Serial Clock for JTAG	
6	GND		Logic Ground	
7	PORESET	Bi-direct	Power On Reset	"0": Reset active
8	EN_BJHRES	Input	Enable buffered HRESET	"0": HRESET enabled.
9	WE0_IORD	Bi-direct	Write Enable Flash upper	"0" : Write enable
10	WE1_PCDE	Bi-direct	Write Enable Flash lower	"0" : Write enable

In Circuit Programming Port

With the In Circuit Programming Port, both CPLDs can be programmed or updated in a Daisy Chain queue.

Connector denotation: **ISP/**

Type: male connector, 2x 5-pin, 180 °, pin 4: coding pin

The function of the individual pins is given in the following table . The definition as an input/output is seen with reference to PCB Control CS_CI.

ISP/

Pin Number	Signal	input/output	Function	Definition
1	ISP_SCLK	Input	Serial ISP Clock	
2	GND		Logic Ground	
3	ISP_MODE	Input	ISP Mode Select	
4	Code		Coding pin	
5	ISP_EN	Input	Enable In Circuit program.	"0": ISP enable
6	ISP_SDI	Input	Serial Data In	
7	ISP_SDO	Output	Serial Data Out	
8	+5V		Logic supply	
9	NC			
10	NC			

.

2.5.2.8 Interface to PCB Modem Supply CS_M

The interface to PCB Modem Supply CS_M is realized by the connectors MO_SU/ and RS232_E/.

MO_SU/ delivers the voltage +26,5 for the modem supply generation, RS232_E/ receives the generated modem voltage +8V for the PCB Control CS_CI.

Connector denotation: **MO_SU/**

Type: multipoint connector 1 X 3 pin., 180°,

reverse terminal protection, MODU II

The function of the individual pins is given in the following table . The definition as an input/output is seen with reference to PCB Control CS_CI.

MO_SU/

Pin Number	Signal	input/output	Function	Definition
1	+UVERS	Output	Supply Voltage + 26,5V	
2	EN_MOSU	Output	Enable Modem Supply	Open, high: enable Low: disable
3	GND24V	Output	Ground	

Connector denotation: **RS232_E/**

Type: male connector, 2x 5-pin, 180 °

The function of the individual pins is given in the following table . The definition as an input/output is seen with reference to PCB Control CS_CI.

RS232_E/

Pin Number	Signal	input/output	Function	Definition
1	+5V	Output	Logic Supply	Reserved
2	+5V	Output	Logic Supply	Reserved
3	GND		Ground	
4	GND		Ground	
5	SMRXD1	Input	Receive (RXD)	Reserved
6	SMTXD1	Output	Transmit (TXD)	Reserved
7	GND		Ground	
8	**V_MODEM**	**Input**	**Modem Supply +8V**	
9	EKGTRIG_E	Output	ECG Trigger	Reserved
10	FERNST_E	Input	Remote Start Input	Reserved

2.6 Interfaces to peripherals

The MAC1200 has only 3 interfaces for peripherals:

- Mains input
- Patient input
- RS-232 interface

The **mains input** interface on the device is a 3-pin standard cold appliance socket connection, which is integrated into the mains input module. Connection to the mains is effected via a 3-pin power cord with a non-fused earth conductor.

The mains input is a wide range input from 95Vac ... 240Vac. The mains input module contains the two primary fuses.

When replacing these fuses, the following points have to be observed:

- replacement by factory or servicing agent only!
- disconnect mains plug!
- replacement only with the original fuses!

For the **patient input**, the mechanics of the patient input of the MAC500 is used, so the patient cables of the MAC1000/CardioSmart cannot be used for the MAC1100/1200/1200 ST.

A 9-pin sub-D Connector, type Mark II with 4-40 UNC inserts, with a standard configuration of the signals TXD, RXD and GND is implemented in the construction of the **RS-232 interface**.

2.6.1 Electronic interfaces

2.6.1.1 RS-232 interface

The 9-pin sub-D Connector of the RS-232 interface is implemented on the PCB Control CS_CI directly.

From Version V1.1, the remote start input pin is available on pin 8.
In MAC1200 US devices the modem supply output +8V is available on pin 6 additionally.

Connector denotation: **RS232/**

Type: 9-pin sub-D, female, Mark II with 4-40 UNC inserts

The function of the individual pins is given in the following table . The definition as an input/output is seen with reference to PCB Control CS_CI.

RS232/

Pin Number	Signal	input/output	Function	Definition
1	NC			
2	RXDE	Input	RS232 Data In	
3	TXDE	Output	RS232 Data Out	
4	NC			
5	GND		Signal Ground	
6	**V_MODEM**	**Output**	**Modem Supply +8V**	**MAC1200 US only**
7	RTSE	Output	Request to Send	
8	**FERNST**	**Input**	**Remote Start Input**	**"0" : active**
9	NC			

2.6.1.2 Patient input

The connection to the patient cable is realized with a 15-pin female sub-D Connector, implemented on the PCB Control CS_CI directly. The mechanical plastic housing makes sure that for MAC1100/1200/1200 ST only released patient cables can be connected.

Connector denotation: **EKG/**

Type: 15-pin sub-D, female

EKG/

Pin Number	Signal	input/output	Function	Definition
1	C2	Input	chest lead V2	
2	C3	Input	chest lead V3	
3	C4	Input	chest lead V4	
4	C5	Input	chest lead V5	
5	C6	Input	chest lead V6	
6	Shielding	Output	shielding AVSS	
7	Cable	Input	Identification: patient cable used	"0": patient cable used
8	Cable identification	Input	5/10 -pin or 12 -pin cable used	"0": 12-pin cable "1": 5- or. 10-pin cable.
9	R (RA)	Input	electrode right arm	
10	L (LA)	Input	electrode left arm	
11	F (LL)	Input	electrode left leg	
12	C1	Input	chest lead V2	
13	NST	Input	Nehb electrode NST	
14	N (RF)	Output	electrode right leg	
15	NAX	Input	Nehb electrode NAX	

2.7 Software Updates

Software updating can be performed via RS232 with the Software **Download Kit part-No. 2000079-001**. The required connection cable and a description of the procedure is included in the kit.

2.8 Limitations

The following operating modes are not implemented in the MAC1100/1200/1200 ST

- No SAO2
- No spirometry
- No late potentials, no RR variability
- No phono, no US Doppler

A scope output is not available.

No analog inputs.

No ECG trigger output.

Lead acid accumulators cannot be used.

Primary cells cannot be used.

3 System test functions

All messages displayed during the self-test are in English.

3.1 General information

The functions for the system test are mostly menu-guided.

For complete execution some tests require special auxiliary resources. These include interface testers or PC, connection cables, signal generators, etc. The tests that are necessary are described in the various test descriptions.

3.2 Test start

After simultaneously pressing the keys

Shift + 12 Lead (or Auto)

the initial display menu appears to enable selection of a specific test. (see below)
The specific test functions are activated by pressing the corresponding key.

Hardware tests

1= Display test
2 = Keyboard
3= Motor test
4= Test results
5= Recording test
6= V24 tests
7= Time and date
8= Electrode test
D= Device model
H= Interpretation
N= Serial number

X= End (Terminate hardware tests)

3.3 Display test

After pressing the **"1" key** the following menu appears:

Display test

(1) Test pattern
(2) Clear display
(3) Restore menu

(4) Inverse
(5) Display illumination
Contrast control
- Shift_Cursor_Down
- Shift_Cursor_Up

Terminate with any key

Pressing any other key than one of those listed in the menu above leads back to the initial display menu.

(1) Test pattern

Pressing this key generates a chessboard pattern. Each subsequent pressing generates the inverse display of its predecessor.

(2) Clear display

All display pixels are inactive

(3) Restore menu

The initial display test menu is displayed.

(4) Inverse

The contents of the existing display appear in reverse video.

(5) Display illumination

The illumination is switched on or off by pressing this key.

Contrast control
The contrast setting can always be adjusted as described above (cursor keys).

3.4 Keyboard test

By pressing the **“2" key** the following menu appears:

Key T e s t

B= Bleeper test

E= End

When a key is pressed this key or its function is displayed. This can either occur by a triple character display, e.g., “AAA” or as a text, e.g., "CURS_UP". Moreover, pressing the “B” key tests the bleeper (audible sound). The keys “ALT” and “SHIFT” only in combination with another key. The “E” key terminates this test and simultaneously undergoes a self-test.

3.5 Motor test

When the “3" key is pressed the following menu appears:

Motor Speed Test
- Speed selection key
- Start/Stop key

Terminate with any key

The speed select key is used to set the required speed and the motor is set into motion with Start/Stop.
A marking pulse is set once every second. The running speed can then be calculated or its accuracy checked from the distance between marking pulses. Any other key pressed not included in this menu leads to the initial display menu.

3.6 Test results

Pressing the **"4" key** triggers the output of the test results.

The output of the test protocol supplies the following information:

- Time and date
- Device serial number
- Device model
- Software release
- ECG time constant
- Battery voltage
- test results
- Memory used (ROM, RAM)
  - base address
  - size

Following output, the initial display menu reappears automatically.

The identification of the Hardware Version is given by the item "Remote Control yes/no".
"No" indicates Hardware Version V 1.0 (no remote control), "yes" indicates Hardware Version V 1.1 or V1.2

3.7 Self-test

The test results elucidated in Section 3.6 are ascertained during the self-test, which is always performed on power-up. Should errors be detected, a message appears on the display after the test, indicating the possible errors. The following error codes are used to identify the error.

Error codes

The following error codes appear on the display together with the message "Self-test failed":

ERROR_CODES:
0 - reserved
1 VEKT - error in vector table
2 DRAM - DRAM error
3 SRAM - SRAM error
4 - reserved
5 - reserved
6 - reserved
7 - reserved
8 ROMB - ROM error (checksum) in the FLASH
9 - not used
10 - not used

3.8 Recording test

The recording test is activated by pressing the **"5" key**.

A window with 2 channels is displayed.

- speed select key: selects the speed
- start/stop key: starts and stops a real time 2 channel recording

The selected speed and sensitivity is displayed.

Terminate with any key.

3.9 V24 tests

Several possibilities are available to test the serial interface. Moreover, on the one hand, the signal transmission and receiving of the interface can be tested by an internal feedback from TXD and RXD and, on the other hand, the signal transmission and receiving with a remote station.

For the test with a remote station, the connection cable from MAC1100/1200 to PC, PN 223 362 03 is required. In addition, the following transmission protocol should be adjusted at the remote station:

1 start bit, 8 data bits, no parity
1 stop bit
Baud rate 19200

Pressing the **“6" key** calls up the following menu:

Interface test

1= Sending and receiving
2= Send test string to device
3= Send/Receive with device

A = Abort (terminate interface test)

(1) Sending and receiving
This test enables complete testing of the RS232 signal path for transmitting and receiving, including RS232 driver and connector.
This test requires an RS232 connector with an internal bridge from pin 2 (RXDE) to pin 3 (TXDE). Depending on the result of the test, the following message appears:

If test result is OK: Out :Hello world!
In :Hello world!

If an error occurs: Out :Hello world!
In : ERROR (In)

(2) Send test string to device
In this test a remote station, e.g., PC must be connected up and have a terminal program which can receive signals and be configured for the above-mentioned protocol. If the remote station is on receive, then every time the “2" key is pressed the test string “Hello world!” is transmitted to the remote station. Simultaneously, the following message appears on the display:

v24-Settings: “19200, 8, n, 1“

Out: Hello world!

(3) Send and receive with device
Sending and receiving can be tested with a remote device by pressing the “3" key. The device should be connected as described in (2).
After pressing the “3" key a test string is sent to the remote station. The following message appears on the display:

Transmitting: Hello world!

Receiving: [ ]

A subsequent input at the remote station is sent back to the device and displayed there. Moreover, it should be noted that an input must take place within 10 s and the input terminated with “return”.

3.10 Time and date

This section deals with the quick checking and setting of the time and date.
Pressing the **"7"** key calls up the following display:

Time (hh:mm) [18:25:29]

and

Date (dd.mm.yyyy) [03.03.1999]

X = End

To set time or date, select the corresponding time or date field by pressing the return key.
During entering the numbers, a single cursor is not displayed.

3.11 Electrode test

The electrode test is started by pressing the **"8" key.**
The following menu is displayed:

Electrode test

Terminate with any key

Select pace electrode (key 'P')
Pace electrode LA

Cable = 10 electrodes (or no cable)

The status of each electrode is displayed. Electrode OK or disconnected is displayed as follows:

Status = 0 -> Electrode OK
Status = 1 -> Electrode disconnected

With the "P" key, the pace electrode can be selected. The selected pace electrode is displayed.

The status **"cable"** indicates if a cable is connected to the patient ECG input or not.

3.12 Time constant

From Software release V5.2 the time constant can no more be set in the service mode. It is accessible in the user mode under “System Setup” (Allgemeine Einstellungen), Baseline roll filter (Nullienienfilter) 0.04Hz, 0.08Hz, 0.16Hz

3.13 Setting the device model

The setting of the device model is activated by pressing the **“D” key**, the following display image appears:

D e v i c e model

1= INT
2= USA
3= Europe 2
4= Japan
5= RUSS

X= End

Warning!

Changing the device model affects the selection of the output formats and languages available, can switch the program for Interpretation from HEART to 12 SL, or vice versa. Also affected are the default configuration settings, e.g., override function yes/no, line filter 50/60 Hz.

The device model configured during manufacture should only be changed when deemed really necessary.

The following table shows the most important combinations:

Device model	Inter-pretation	Output formats	Languages	Default settings	
				Override function enabled	Line filter
01 INT	HEART	international	international	no	50 Hz
02 USA	12SL	USA	e,f,s	yes	60 Hz
03 Europe2	12SL	international	international	yes	50 Hz
04 Japan	12SL	international	e, jap	no	50 Hz
05 RUSS	HEART	international	e,r	no	50 Hz

- Language international: g, e, f, i, s, por, sw, nor, fin, dan, hol, czech, hung
- Europe 2: United Kingdom, Benelux, Scandinavia

The required device model is selected by pressing the appropriate key, **“1"** to **“5".**

Quit selection menu by pressing the **“X“ key.**

Quit the self-test with **“X” key.**

MAC 1100 / 1200 / 1200 ST configures the appropriate items and initiates a cold start automatically. Thus, when the device is rebooted automatically all the new settings are adopted.

Selecting a particular device model leads to the configuration of the program for Interpretation as indicated in the table above, even when the interpretation program was configured differently beforehand as described in Section 3.14.

Note on saved ECGs when configuring the device model:

Saved ECGs are not lost.
If a new device model is selected, the program for Interpretation is switched over; however, when printing out the saved ECGs the display in the status line (12SL, or without in the case of HEART) is related to the currently enabled program for Interpretation, although the results are based on the program previously configured. In this case, the saved ECGs should be printed out or transferred to a PC before configuration of the new model.

3.14 Switching over the program for interpretation

Switching over the program for interpretation is activated by pressing the **"H" key**, the following display image appears:

I n t e r p r e t a t i o n

1= HEART
2= 12SL

X= End

The currently enabled interpretation program appears in reverse video.

Warning!

Switching over to another program for Interpretation affects the measurement results and the interpretation!

The program for Interpretation configured during manufacture should only be changed when deemed really necessary!

The required program for Interpretation is selected by pressing the appropriate key, **"1"** or **"2".**

Quit the selection menu by pressing the **"X" key.**

Quit the self-test with the **"X" key.**
MAC 1200 / 1200 ST configures the appropriate items and initiates a cold start automatically. Thus, when the device is rebooted automatically all the new settings are adopted.

Note on saved ECGs when switching over the program for Interpretation:
Saved ECGs are not lost.
After switching over to a different program for Interpretation when printing the saved ECGs the display in the status line (12SL, or without in the case of HEART) is related to the newly selected interpretation program, although the results are based on the program previously configured. In this case the saved ECGs should be printed out or transferred to a PC before switching over to the new program for Interpretation.

3.15 Pace enhance

From Software release V5.2 the Pace enhance mode can no more be set in the service mode. It is accessible in the user mode under “System Setup” (Allgemeine Einstellungen), Pace Enhancement (Pace Markierung) YES or NO.

3.16 Serial number

The serial number of the device is displayed by pressing the **“N” key.**

The serial number is only displayed and cannot be changed.
The serial number is entered during the manufacturing process.

After replacing the PCB Control CS_CI, during the power up sequence, the serial number of the device has to be entered.

Terminate with the **“X” key.**

3.17 Ergometer / Treadmills (only JAPAN device model)

In the japanese device model of MAC 1200 ST the drivers for Ergometers and Treadmills can be switched ON or OFF.

Ergm / Treadmills

1 = YES (drivers are available in Stress Test mode)
2 = NO (not available)

4 Repair instructions

4.1 Safety instructions

Repairs may only be conducted by approved specialist personnel.

Before opening the MAC 1100 / 1200 / 1200 ST, switch off device and disconnect mains plug!
Never connect mains plug when the device is open!

Before replacing the primary fuses in the power input module, the device should also be switched off and the mains plug disconnected!

For replacing components, only the original Marquette components, mentioned in the spare parts list may be used!

When replacing electronic components implement **ESD protection.**
Return replaced PCBs in **ESD packaging** only.

Defective NC batteries or empty batteries should be **disposed of in accordance with the applicable legal stipulations** or returned to the factory**.**
Batteries returned to the factory should be labeled **"For disposal"**.

4.2 Replacing components

For all the following points the safety instructions in Section 4.1. have to be observed!

Warning: The device has to be switched off!

Opening the device

To open the device release the 5 fastening screws on the underside of the device, open the paper feed flap, carefully raise the upper shell of the housing, disconnect keypad cable by opening the connector KEYB/ on the PCB Control.
The display remains in the lower shell of the casing.

During reassembly, ensure that no cables are pinched.

Replacing the primary fuses in the mains input module

Warning: Only use fuses indicated on the rating label! (see Section 8, Parts List)

Replacing the battery

Disconnect and lift out the battery compartment on the underside of the device by raising the middle fastening catch. Remove the battery and disconnect the battery plug BATT_IN/ from the PCB Battery Charge.

Warning: Only original Marquette batteries may be used! (see Section 8, Parts List)

Defective NC-batteries or empty batteries should be **disposed of in accordance with the applicable legal stipulations** or returned to the factory**.**
Batteries returned to the factory should be labeled **"For disposal"**.

Before putting in the new battery, insert plug BATT_IN/. Push in battery compartment, secure by pressing on the fastening catch.

Replacing the PCB Battery Charge

After opening the device, first of all open the battery compartment and disconnect the battery connector BATT_IN/ (see "Replacing the battery").
Then disconnect the connector BATT/ from the PCB Control. Undo the fastening screw next to the inductor L1 on PCB Battery Charge.
PCB Battery Charge has one soldered fuse:

SI 1: Battery fuse

No adjustments on the PCB Battery Charge are necessary.

Replacing the PCB Control

Before replacing the PCB, if still possible, printout the settings configured by the user and check the options enabled.

After opening the device first of all disconnect the plug-in connector POSUP/ to the power supply unit, and the connector BATT_IN/ from the PCB Battery Charge. Make sure that the connector BATT_IN/ makes no contact with the coated shell, while disconnected. Then disconnect the remaining connectors to the recording unit. Undo the 6 PCBs fastening screws.

Check whether the connection LOET2 of the lithium battery for the real-time clock (BA1) is correctly soldered. Also check whether the connection LOET1 of the backlight inverter is soldered correctly.
Insert new PCB, fix the fastening screws and plug in connectors.

Connect keypad in the upper shell to connector KEYB/ and close connector on PCB Control and set the upper shell on to the lower shell. Tighten the 5 fastening screws.

Load the software via RS-232 interface with the Software Download Kit part No. 2000079-001.

Enter the device serial number.

If required, enter the option codes as described in the Operator's Manual.

Adjust the display contrast.

Setting the date and time (Section 3.10).

If known, adopt the user-programmed configuration; otherwise, default setting.

Replacing the motor

After replacing the motor, no adjustment of speed is necessary. Nevertheless run the motor test (Chapter 3.5).

Replacing the graphics display

After opening the device first of all open connector KYO/ and release the flat ribbon cable of the display. Undo the screws of both plastic display holders, shift it 2 mm in the direction to the handle and lift up display and holders. Disconnect the plug HOS_BL/.
To re-assemble do vice-versa.

Adjust the contrast with the new display.

5 Troubleshooting tips

For all the following points the safety instructions in Section 4.1. have to be observed!

Device cannot be switched on even though power plug is plugged in

- *green power lamp LED is off and device cannot be switched on:*

  - Power cable defective or not plugged in correctly?
  - Primary fuses in the mains input module defective?
  - Connector from the mains input module to the mains switching power supply plugged in correctly, or cable defective?
  - Connector from the mains switching power supply to connector POSUP/ on the PCB Control plugged in correctly, or cable defective?
  - Keypad via connector KEYB/ on PCB Control plugged in correctly?
  - 26,5V on the connector POSUP?
    → if no: - *mains switching power supply defective*
    → if yes: - *PCB Control defective*
    - *or keypad defective*

- *green power lamp LED is on, but device still cannot be switched on:*

  → - *PCB Control defective*
  - *or keypad defective*

Device cannot be switched on when being battery-operated only

- *Is the battery depleted?*

  - Plug in power plug, green power lamp LED should glow and the device can be activated,
    → if not: - *refer to "Device cannot be switched on even though power plug is plugged in".*
  - By connecting the power plug, rapid charging is activated, LED1 on the PCB Battery Charge is activated
    → if not: - *PCB Battery Charge is defective*
  - With power plug plugged in, let unit charge for 10 minutes, then disconnect power plug. Can the device be switched on and can a recording be started?
    → if yes: - *Function OK., continue loading with plugged mains plug*
    → if not: - *Battery disconnected or cable defective?*
    - *Battery defective (no capacity)?*
- *PCB Battery Charge defective (Si1?)?*

No display on the screen

- Does the yellow Stop LED on the keypad glow after the device is switched on?
  → if not: - refer to "Device cannot be switched on ...."
  → if yes: - continue
- Does a beep sound approx. 10s after switching on the MAC1200 occur (indicates the successful power up self-test)?
  → if not: - *Self test error, PCB Control defective*
  → if yes: - continue
- Contrast badly adjusted?
- Can the background illumination be activated by pressing a key?
- Can the display test in Section 3.3 be applied successfully?
  → if not: - *graphics display module defective*
  - *or PCB Control defective*

Error in self-test identified

When an error is detected during the self-test, in addition to the message “Self-test failed”, the error code number and a short description also appear on the display. The meaning of the error codes is described in Section 3.7. The error codes refer to the PCB Control, and should be noted as information for the service center.

MAC 1200 fails to give printout, **no paper transport**

Perform the following test in the 6-lead operating mode:

- Paper available? Paper correctly inserted? Paper transport problems (jam)?
- Paper feed flap correctly engaged on both sides?
- After pressing the start key, the green start Led must glow
  → if not : - *keypad defective? Apply keypad test in Section 3.4*
  → if yes: - continue
- Paper feed flap correctly engaged on both sides?
- Mark reader defective or not plugged in?
- All connections for printhead and Motor are plugged in?
- Motor blocked ? (check roller, transmission)
- Operating only on battery which is strongly depleted?
  → if yes: - *plug in power plug*
  → if not: - *PCB Control defective*

Paper transport functions, no printout

- Paper feed flap correctly engaged on both sides?
- All connectors for printhead plugged in?
- Operation with strongly depleted battery?
  → if yes: - *plug in power plug*
  → if no: - *PCB Control defective*
  - *or printhead defective*

MAC 1200 only prints on the upper or lower section of the printout

- Paper feed flap is only engaged on one side.

MAC 1200 prints, but only baselines are printed out

- Electrodes applied correctly?
- Electrode cables plugged into the patient trunk cable terminal-box correctly?
- Patient trunk cable defective (e.g., RL defective)?
- Contact problems at the patient input connector of the MAC1200?
  → if not: PCB Control defective.

6 Adjustment instructions

For MAC 1200 no adjustment of components is required.

When PCB Control CS_CI, or the graphics display has been exchanged, the display contrast should be adjusted to an optimum contrast ratio as described in the user manual.

7 Servicing and maintenance

7.1 Technical inspection

A technical inspection is to be performed once a year. The following items, including the accessories used, are to be performed:

- Check device and accessories for mechanical defects, which impair their function.
- Perform a function check as detailed in Section 3 “System test functions”.
- Check labels and inscriptions on the device relating to safety are clearly legible.
- Measure the Protective Earth Resistance (see Section 7.1.3 /7.1.3.2).
- Measure the enclosure Leakage Current (see Section 7.1.3 /7.1.3.3.1).
- Measure the patient leakage current (see Section 7.1.3 /7.1.3.3.2).

Warning!
The following checks may only be performed by persons whose training, knowledge and practical experience enable them to carry out such checks reliably and correctly!

Notes:
The operational and functional reliability of the device is checked using the following checklists.
They serve the experienced technician when checking the device.
A knowledge of device operation as detailed in the “Operator’s Manual” is assumed.

The checklist items are based on the testing instruments given below.
The tests should be carried out using the customer’s accessories, so that defective accessories are also detected automatically.
If other testing instruments are used besides those mentioned, the items on the checklist and tolerance specifications may need to be modified.

7.1.1 Visual check

Device and accessories are to be checked to ensure that
- fuse cartridges comply with vendor’s specifications;
- labels and inscriptions on the device relating to safety are clearly legible;
- the mechanical state of the device permits its further use;
- there is no fouling which could cause any reduction in safety.

7.1.2 Test functions

7.1.2.1 Recommended testing instruments and accessories

1x Multi-parameter simulator Lionheart

1x RS232 interface connector with internal connection between pins 2 and 3 (TXD and RXD)

1x Patient trunk cable and customer electrode leads,
or 1X patient trunk cable, 10-pin 223 387 01

7.1.2.2 Test preparations

In general, the device test functions implemented in MAC 1200 are used for the tests.
These are described in Section “3. Device test functions”.

Connect MAC 1200 up to the mains, the green LED for standby must glow.
Switch the device on, the self-test runs automatically, no error message should appear. When the self-test has finished the device is in the automatic mode, the yellow LED for still disabled operating mode must glow.

Modifications in the user-programmed configuration may need to be made in order to carry out the test. Should such a change need to be made to enable testing, make a printout of all the modified configuration lists and mark the changes made.

Important: After completing the test the original user-programmed configuration is to be retrieved and activated.

7.1.2.3 Operating and display unit performance tests

- Carry out the “Display test (1)” as detailed in Sections 3.3, respectively.
- Carry out the “Keypad test (2)” as detailed in Sections 3.4, respectively.

7.1.2.4 Test for recording speeds 25 and 50 mm/s

- Carry out the “Motor test ” as detailed in Sections 3.5, respectively.
- The feed speed deviations should be less than 3%.

7.1.2.5 Device Test result check

- Output “Test results ” as detailed in Sections 3.6, respectively.
  - Main parameters: - all memory stores free from error?
    - ASIC test O.K?
    - Sample rate 1000?
    - Printhead voltage > 18V, battery charge O.K?
    - Printout clearly legible and without any lapses or interference?

7.1.2.6 RS-232 interface test

Carry out the “Interface test ” test item “(1) Transmitting and receiving”, as detailed in Section 3.9, respectively.

7.1.2.7 Analysis of the ECG signals and HR value

Carry out the following settings on the ECG simulator:

- Amplitude 1 mV
- Heart rate (RATE) 60 bpm

Connect the electrode leads as indicated below:

R, red	(or RA)	----->	RA
L, yellow	(or LA)	----->	LA
F, green	(or LL)	----->	LL
N, black	(or RL)	----->	RL
C1, white/red	(or V1)	----->	V1
:		:	:
:		:	:
C6, white/violet	(or V6)	----->	V6

Switch in **6 lead operating mode** and start recording by pressing the Start key.

By pressing the lead scrolling key, check whether all leads **are being recorded.**
The ECG traces must be **noise-free**.

Record one page in the “6-lead” operating mode. The following annotations must be present:

- Heart rate (top right)
- Lower status line
  - date and time
  - recording speed
  - sensitivity
  - active filter, e.g., 50/60 Hz, 40/20 Hz, ADS
  - frequency range of the recording

The **heart rate** of 60 bpm +/- 2 bpm appears on the display and is printed out on the recording.

Activate the square-wave function on the ECG transmitter at 1 mV.
Using the lead scrolling key select lead II. The square-wave pulse trace must correspond in **amplitude** with the displayed 1 mV reference pulse (applicable to named transmitter only).

Switch back to ECG signal on the ECG transmitter.
Start the recording in manual mode.
Increase the **heart rate to 200 bpm** on the ECG transmitter. The acoustic **warning signal** must sound for about 1s. Reduce the heart rate back to 60 bpm, the warning signal no longer sounds.

7.1.2.8 Pacemaker identification test

Make the following settings on the multifunction simulator:
- pace setting
- pace amplitude 6 mV
- pace duration 0.2 ms

Adjust “6-lead mode” on MAC 1200 device to be tested and select lead groups I, II and III.
Start the recording. The pace pulses must be visible as needles on the recording output.

7.1.2.9 Identification of disconnected electrodes

Reset the simulator to ECG signal at a heart rate of 60 bpm. Remove one electrode after the other from the ECG transmitter.

Activate the “12 lead” mode in the MAC 1200 device to be tested without activating it by pressing the Start key.
Check to ensure that each disconnected electrode is displayed correctly and that an acoustic alarm signal sounds.

7.1.2.10 Checking the charge status of the NC battery

The NC battery can, among other things, be checked as follows:
discharging the battery, followed by charging up completely (duration 4 h), followed by discharging in standby mode without recording.
If the operating time for this procedure is under 2.5 h, the battery should be replaced.

7.1.3 Safety Analysis Tests

7.1.3.1 General information

The suggested Safety Analysis Tests refer to the international standard IEC 601-1.
The tests are generally performed with Safety Testers, on most of them, the measuring circuits according IEC 601 are already implemented.
The following is a general description of the tests to be performed. For the handling of your Safety Tester follow the user manual.

The tests may be performed under normal ambient conditions of temperature, humidity and pressure and with line voltage.
The leakage currents correspond to 110 % of rated voltage for the tested unit. Most Safety Testers take this into account, otherwise the measured values have to be calculated.

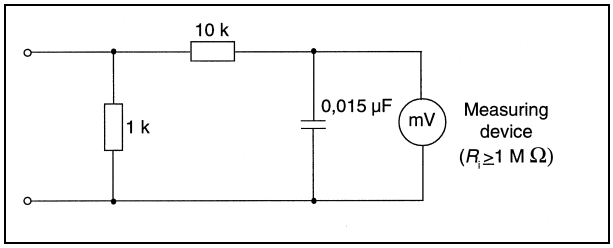
Recommended Test Equipment

- Safety Tester for measurements according to IEC 601.
- Testing connector according to the following description.

7.1.3.2 Protective Earth Resistance Test

The power cord is to be included in the protective earth resistance test.
This test determines whether the device has a power ground fault.

- The protective earth resistance from power connector to any protective earth connected exposed conductive part is measured.
- Specs. of test circuit: AC current source 50 Hz/60 Hz of at least 10 A up to 25 A with limited output voltage of 6 V.
- If resistance is greater than 100 mOhm, the unit fails this test.



7.1.3.3 Measurement of Leakage Current

To perform the suggested measurements, the unit being tested has to be separated from any interconnection to a system. If the unit is part of a system, extended tests according to IEC 601-1-1 have to be performed. The following diagram shows the
Measuring Circuit [M] required for leakage current. The reading in mV corresponds to µA (leakage current). The Safety Testers generally work with this Measuring Circuit [M] and the displayed values are already converted to leakage current.

7.1.3.3.1 Enclosure Leakage Current Test

This test is performed to measure leakage current from chassis to ground during normal condition (N.C.) and single fault conditions (S.F.C.).
In all cases, the leakage current is measured from any exposed conductive parts to ground, the unit being tested has to be switched on and off.

Connect the unit being tested to your Safety Tester.

- During normal condition (N.C.), referring to the electrical diagram, measurements have to be done under the following conditions:

* Polarity switch Norm and RVS
* GND switch GND closed
* S1 closed and open

- During single fault conditions (S.F.C.), referring to the electrical diagram, the measurements have to be done under the following conditions:

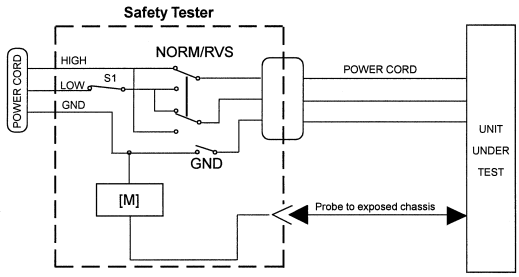
* Polarity switch NORM and RVS
* GND switch GND open
* S1 closed

Test has failed if the measured values are greater than:

N.C.	S.F.C
100 µA	500 µA
	300 µA (UL requirements)

Electrical Diagram for Enclosure Leakage Current Test

7.1.3.3.2 Patient Leakage Current Test



This test performs a leakage current test under single fault conditions (S.F.C.) depending on domestic power outlet of 115 or 230 V AC as source into the floating inputs.

In all cases, the leakage current is measured from input jack of the unit being tested to ground.

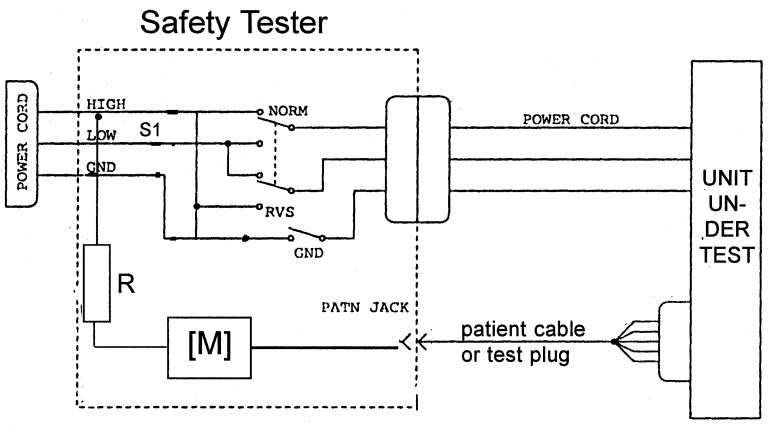
Connect the unit being tested to your Safety Tester.

- Referring to the electrical diagram, measurements have to be done under the following conditions:

* Polarity switch NORM and RVS
* GND switch GND closed
* S1 closed

Test has failed if the measured values are greater than 50 µA.

Electrical Diagram for Patient Leakage Current Test



For the protection of the test person, the following values of resistor R may be used:

Type BF	22 kOhm (120 to 130 V)
	47 kOhm (220 to 240 V)
Type CF	100 kOhm (220 to 240 V)

7.2 Maintenance, cleaning, disinfection

MAC 1200 maintenance, cleaning, disinfection is performed in accordance with the MAC 1200 “Operator’s Manual”, Section 11, "Cleaning, disinfection and maintenance", as applicable.

Applications requiring extensive recordings may result in deposits on the thermal array printhead which normally do not, however, have any adverse effect on the printing quality. This can be removed with a soft, fluff-free cloth soaked in an alcohol-based cleaning agent (e.g., surgical spirit).

8 Parts List

Partnumber Description

MAC 1100

10116801	MAC 1100	(int.)	Basic unit	with Battery without Pump
10116802	MAC 1100	(int.)	Basic unit	with Battery with Pump
10116807	MAC 1100	(russ.)	Basic unit	with Battery without Pump
10116808	MAC 1100	(russ.)	Basic unit	with Battery with Pump
10116809	MAC 1100	(europe2.)	Basic unit	with Battery without Pump
10116810	MAC 1100	(europe2.)	Basic unit	with Battery with Pump
10116811	MAC 1100	(int.)	Basic unit	without Battery, without Pump
10116817	MAC 1100	(russ.)	Basic unit	without Battery, without Pump
10116819	MAC 1100	(europe2.)	Basic unit	without Battery, without Pump

MAC 1200

10116821	MAC 1200	(int.)	Basic unit	with Battery	without Pump
10116822	MAC 1200	(int.)	Basic unit	with Battery	with Pump
10116823	MAC 1200	(USA.)	Basic unit	with Battery	without Pump
10116827	MAC 1200	(Russ.)	Basic unit	with Battery	without Pump
10116828	MAC 1200	(Russ.)	Basic unit	with Battery	with Pump
10116829	MAC 1200	(europe2)	Basic unit	with Battery	without Pump
10116830	MAC 1200	(europe2)	Basic unit	with Battery	with Pump

MAC 1200 ST

10116831	MAC 1200 ST - (int.)	Basic unit	with Battery	without Pump
10116835	MAC 1200 ST - (int.)	Basic unit	with Battery	with Pump
10116834	MAC 1200 ST - (Jap.)	Basic unit	with Battery	without Pump
10116832	MAC 1200 ST - (europe2)	Basic unit	with Battery	without Pump
10116836	MAC 1200 ST - (europe2)	Basic unit	with Battery	with Pump
10116837	MAC 1200 ST - (RUSS)	Basic unit	with Battery	without Pump
10116838	MAC 1200 ST - (RUSS)	Basic unit	with Battery	with Pump

User Manual MAC 1100 / 1200 / 1200 ST

22749201	User Manual MAC 1100 / 1200 / 1200 ST	German
22749202	User Manual MAC 1100 / 1200 / 1200 ST	English
22749203	User Manual MAC 1100 / 1200 / 1200 ST	French
22749204	User Manual MAC 1200	English,USA
22749205	short User Manual MAC 1100 / 1200 / 1200 ST	Italian
22749206	short User Manual MAC 1100 / 1200 / 1200 ST	Spanish
22749207	User Manual MAC 1100 / 1200	Russian
22749208	User Manual MAC 1100 / 1200 / 1200 ST	Swedish
22749209	short User Manual MAC 1100 / 1200 / 1200 ST	Portuguese
22749210	short User Manual MAC 1100 / 1200 / 1200 ST	Norway

22749211	short User Manual MAC 1100 / 1200 / 1200 ST	Danish
22749212	short User Manual MAC 1100 / 1200 / 1200 ST	Finnish
22749213	short User Manual MAC 1100 / 1200 / 1200 ST	Dutch
22749214	short User Manual MAC 1100 / 1200 / 1200 ST	Hungarian
22749215	short User Manual MAC 1100 / 1200 / 1200 ST	Polish
22749216	short User Manual MAC 1100 / 1200 / 1200 ST	Czechoslovakian
22749218	short User Manual MAC 1200 ST	Japanese

Service Manual

22749221	Service Manual USA. for MAC 1200
22749220	Service Manual International for MAC 1100/1200/1200ST

Housing Parts

43252578	Under -case shell
92401714	Rubber foot
43252198	Battery cover

Upper Case for MAC 1200 / MAC 1100

2000074-001	Upper case with keypad and filter pane (Russ.)
2000075-001	Upper case with keypad and filter pane (Int.)
2000076-001	Upper case with keypad and filter pane (USA)
2000077-001	Upper case with keypad and filter pane (Europe 2)

Upper Case for MAC 1200 ST

2006893-001	Upper case with keypad and filter pane (INT 1)
2006894-001	Upper case with keypad and filter pane (INT 2)
2006895-001	Upper case with keypad and filter pane (USA)
2006896-001	Upper case with keypad and filter pane (JAPAN)
2006897-001	Upper case with keypad and filter pane (RUS)

2000088-001	Filter pane complete with glue frame
43252554	Sign Marquette Hellige
43252555	Sign GE Medical systems
43252559	Instrument Label MAC 1100
43252560	Instrument Label MAC 1200
43252561	Instrument Label MAC 1200 ST
30344319	Handle
41611818	Leaf Spring
92916645	Luer- connection (female)
92916648	Luer Nut
92916654	Luer-cap
43252566	Filler Panel
43252567	Connector Pan

Recorder Parts

2000078-001	Drive Flap complete with Gearwheels and Roller
48015967	Gearwheel assembled on Roller
48015969	Gearwheel assembled on Motor
48015966	Gearwheel big, assembled between Roller and Motor
2009848-001	Motor Update Kit (replace Motor part no 30344746)
43252213	Cover plate for Motor
30343829	Mark Reader old. Used up to **S/N 101082178**
2001495-001	Mark Reader new. Used from **S/N 101082179** and higher.
30344271	Thermal Printhead
38802910	PCB Printhead connection
43252209	Plastic holder for Printhead left side
43252210	Plastic holder for Printhead right side
41515439	Pressure spring for Printhead
50465725	Metal Tube
50465774	Contact Plate
50465726	Press Strip

Keypads MAC 1200 / MAC 1100

39000200	Keypad International
39000201	Keypad Europe2
39000202	Keypad USA
39000203	Keypad Russ.

Keypads MAC 1200 ST

200 5766-001	Keypad MAC1200ST International
200 5767-001	Keypad MAC1200ST Europe2
200 5768-001	Keypad MAC1200ST USA
200 5769-001	Keypad MAC1200ST Japan

Electronic components / PCBs

91541936	Line filter with fuse holder
30344270	Battery
38803290	PCB Battery charging
93011858	PCB. Power Supply
2000070-002	Spare PCB. Control with remote start for MAC 1100
2000071-002	Exchange PCB. Control with remote start for MAC 1100
2000072-002	Spare PCB. Control with remote start for MAC 1200 (backward compatible for all versions)
2000073-002	Exchange PCB. Control with remote start for MAC 1200 (backward compatible for all versions)
2000771-001	PCB Modem Supply CS_M (US only)
91208449	Fuse T 1,25 A

92916717	Battery 3 V 0.255 Ah
30344291	Pump 12 V (Standard)
38803125	PCB. Pump

Display-Module Graphics

2007630-001	Assy LCD-Modul Graphic (replace display part no 93011717)
43252565	LCD Holder right side
43252564	LCD Holder left side

Wire Set

38327399	Wire set for MAC 1100/1200/1200ST
38327409	Wire for pump to PCB.mainboard
2001795-001	Wire from PCB Modem Supply to PCB mainboard (US only)

Connection cable (for MAC 1100/ 1200/1200 ST)

22336203	Connection cable from MAC 1100/1200 to CardioSys/Soft
22337801	Connection cable from MAC 1100/1200 to Modem 9- pin connector
22337802	Connection cable from MAC 1100/1200 to Modem 25- pin connector
22337804	Connection cable from MAC 1200 to Modem 25 with supply (US only)
22336604	Connection cable from MAC 1100/1200/1200 ST to EC1200
22336802	Connection cable from MAC 1200 ST to TM400
22338002	Connection cable from MAC 1200 ST to Ergoline 900/800
2006795-001	Connection cable from MAC 1200 ST to Variobike 500
22339003	Connection cable from MAC 1200 ST to T2000
2006796-001	Connection cable from MAC 1200 ST to Excalibur
2005445-001	Connection cable from MAC 1200 ST to Master Step
2005445-001	Connection cable from MAC 1100/1200/1200 ST to Master Step Device

Service Tool

2000079-001	Software download kit, including connection cable to PC.

Release Software Package

2000284-006	Software Package for MAC 1100 Version V5.2
2000285-006	Software Package for MAC 1200 / 1200 ST Version V5.2
2000285-007	Software Package for MAC 1200 / 1200 ST Version V5.21

9 Specifications

Recording

Direct recording of waveforms and alphanumeric characters with rectangular coordinates by means of thermal-array printhead printing on thermosensitive paper.

- 3 or 6 recording channels, or 12 in 12 Lead Mode, overlapping
- baseline pitch 3 channels: 62 mm (arrhythmia) 6 channels: 31 mm (6 Lead)
  12 channels: 16 mm (12 Lead.)
- writing width 200 mm max.
- annotation of recorder settings, date, time and entered patient name in the margin of the recording strip
- with appropriate software, documentation of analysis results in the respective operating mode
- resolution of the recording:
  vertical 8 dots/mm
  horizontal 25 µm at 25 mm/s

Printer paper

Marquette CONTRAST Z-fold pad , 150 pages per pad, equivalent to a chart length of approx.

45 m

paper width: 8.5 inch

sheet length: 11 inch

To prevent damage to the printhead use only the original Marquette CONTRAST paper or the Marquette thermal paper with queue holes or marks.

Paper transport

- paper speed
  5-25-50 mm/s, key selectable
  error limits at 25 and 50 mm/s, typ. ±l%
  at 5 mm/s, ±10% max.
- At paper end, the recorder emits an audio signal and stops recording
  the last pages of the pad bear a colored stripe in the lower margin

Membrane keypad

Pushbuttons with tactile feedback

- function keys for all routine operations
- alphanumeric keyboard for entry of text

Display

graphics display with 24 x 40 characters, contrast adjustment

resolution of 320 x 240 pixels with display backlighting

Indicators (LED's)

For mains power, battery status and start/stop function

Automatic functions

They assist and facilitate operation by

- automatic control of lead selection, paper feed, calibration (configurable)
- report formatting (configurable)
- automatic baseline adjustment
- anti-drift system (cubic spline) compensating for polarization voltage fluctuations (configurable)

Detection of pacer pulses

- pulse length between 0.1 and 2.5 ms
- pacer pulse marker independent of pulse polarity
- pulse amplitude between ± 5 mV and ± 700 mV

Heart rate indication

derivation of the heart rate from all ECG signals

- display range between 30 and 300 bpm
- display update with every heart beat, maximum every 2 seconds

Signal inputs

isolated patient signal input, IEC type CF, high-voltage protection for all lead connections and neutral electrode, interference compensation via neutral electrode, monitoring for open leads

- electrode connections for RA, LA, LL, LA, VI to V6
- input impedance for differential signals between any two electrode connections > 10 MΩ at 10 Hz
- input impedance for common-mode signals referred to neutral electrode > 50 MΩ up to 60 Hz
- dynamic range for differential signals between any two electrode connections for AC voltage ±10 mV, for superimposed DC voltage (polarization voltage) ±600 mV

- dynamic range for common-mode signals referred to neutral electrode ±l V, referred to chassis 263 V AC (rms.)
- quiescent input current via any electrode connection for l kΩ termination referred to neutral electrode < 50 nA
- patient leakage current (rms values) according to IEC, class CF: in normal condition < 10 µA, in single-fault condition (e.g. patient in contact with line voltage) < 20 µA
- non-destructive range for lead-electrode connections and the neutral electrode connection referred to neutral electrode ±50 V, referred to chassis ±1500 V
- pulse voltage resistance of all lead electrode connections and of the neutral electrode connection referred to chassis (either polarity, e.g. defibrillation) 5000 V
- monitoring of each electrode for open leads: RA, LA, LL, RL, Vl, V2, V3, V4, V5, V6 audio signal at printer start

Data interface

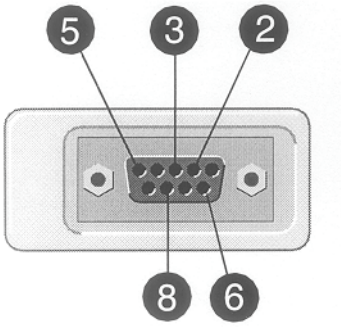
one serial RS232 interface for exchange of data with suitable external devices and software handshake

RS232 interface (standard V.24 interface):

- input voltage range. ± 15V max.
- output voltage range ±5 V min.

interface protected from electrostatic discharge for ±10 kV max.

Pin assignment of data port



2 RXDE

3 TXDE

5 circuit reference

6 Modem Supply (MAC1200 US only)

8 Remote Start Input

Remote Start (hardware)

Paper feed via remote control connection (depending on selected operating mode). External make contact referred to chassis via circuit reference:

- source impedance Ri < 300 Ω
- contact dwell > 100 ms
- non-destructive load ±10V
- ESD interface protection up to ± 10kV

Signal Transmission

Patient input to recording

After lead formation and digitization, simultaneous transmission of all electrode signals to the digital processing system; muscle filter, AC filter, pacing pulse identification, automatic or manual sensitivity adjustment, automatic baseline adjustment and drift compensation by means of the anti-drift system (A.D.S.) can be enabled or disabled simultaneously for all channels; digital output of processed signals via thermal-array printhead.

- low cut-off frequency (-3 db limits) 0.08 Hz, equivalent to a time constant of 2.04 s
- high cut-off frequency (3 dB limits) operating mode: 12 Lead, 6 Lead 150 Hz (IEC/AHA) operating mode: Arrhy 100 Hz (IEC)
- signal sampling rate: 1000/s
- resolution, referred to the input 5 μV
- output rate to recorder 2000/s
- for all leads, gain adjustment in four steps:
  40-20-10-5 mm/mV
- with active muscle filter (low-pass characteristic) 3-dB drop of the amplitude frequency response at approx. 40 or 20 Hz
- with active AC line filter detection and compensation of periodic 50 or 60 Hz frequency components (depending on recorder model) attenuation >40 dB
- non-linear distortion below values specified in IEC and AHA recommendations
- coincidence error limits between any two channels ±0.5 mm
- detection of pacer pulses in V2 or other V leads and marking in all channels for signals referred to patient input:
  duration ≥ 0.1 ms, amplitude > 5 mV
- noise in the signal transmission path below values specified in IEC and AHA requirements:
  ≤ 2.5 μV rms
- common-mode rejection for 50 or 60-Hz signals (depending on recorder model) with AC filter switched on >140 dB

ECG calibration

automatic recording of a defined voltage step, valid for all channels

- calibration voltage, referred to ECG signal input: I mV
  calibration pulse width on recording depends on paper speed
  25 mm/s: 5 mm
  50 mm/s: 10 mm
  5 mm/s: 1 mm

Automatic ECG gain adjustment

The gain automatically adapts to the incoming signal. The maximum amplitude of the lead group or of all leads determines the gain setting.

- automatic adjustment range 5 to 40 mm/mV
- amplitude range (6 channels) 18 to 31 mm

Baseline

automatic adjustment of the baseline to the optimal recording range, in dependence of the signal amplitude

Anti-drift system (ADS) (cubic spline)

automatic compensation of baseline fluctuations caused by polarization voltage fluctuations at the lead electrodes (delay in recording: 4.2 s)

ECG storage

in 12 Lead Mode, storage of up to 40 ECGs

- stored ECGs can be deleted (individually or all in one pass), printed, transferred, and patient data can be edited
- when memory is full user is informed of the possible actions

Blocking

rapid charge reversal of the coupling capacitors in the preamplifiers after electrode application ensures that the baseline is quickly restored to its original position after overranging

Electrode monitoring

audible and visual indication on the LCD of disconnected electrodes or line break; each single electrode is monitored

Text input

patient and user data as well as comments can be entered via the panel keyboard and are annotated on the recording strip

Copy function

after ECG recording in 12 Lead Mode, copies of the ECG can be printed from memory and/or transferred to a MUSE CV system (configurable)

Test

automatic performance test upon power up, including verification of the signal path starting at the signal input

stored test ECG data for demonstration of the device functions

Power supply

from the power line or from a built-in rechargeable battery, automatic switchover; automatic battery charging during line-power operation from integrated AC adapter module

Mains operation

- instrument design in protection class I according to IEC 601-1
- **Rated voltage range 95 to 240 V**
- operating voltage range 85 to 264 V, 49 to 65 Hz
- rated current: 0.2 ... 0.6 A
- fuse 2 x T 1.25A, 5x 20
- typical power consumption battery charging 14 W
- max. power consumption 29 W

Battery operation

- type: nickel-cadmium
- rated battery voltage 18 V
- rated battery capacity 1.3 Ah
- fully charged battery sufficient for up to 50 12 Lead Mode, 1-page ECGs, if unit is only switched on to record the ECGs
- battery charge time approx. 4 hours (min. charge time for one 12 Lead Mode ECG: 10 minutes)
- battery life approx. 2 to 3 years, replacement by service only
- lithium battery for built-in clock, battery life approx. 5 years, replacement by service only

Operational readiness

After successful self-test, approx. 10 s after power-up

Operating position

horizontal

Environment

Operation

- temperature between +10 and +40 °C / 50 and 104 °F
- relative humidity between 25 and 95%
- atmospheric pressure between 700 and 1060 hPa

Transport and storage

- temperature between -30 and +60°C / -22 and +140 °F (including battery)
- relative humidity between 25 and 95%
- atmospheric pressure between 500 and 1060 hPa

Recorder dimensions

- width 370 mm / 14.5 in.
- height 95 mm / 3.7 in.
- depth 320 mm / 12.6 in. (incl. handle)

Weight

- approx. 5.6 kg / 12.3 lb (with battery)

10 Device Documents

The following documents are enclosed:

Assembly drawing:	101 168 01 … 36
Entire Instrument wiring specification	101 168 01 … 36 S, sheet 1
Master Record Index, Version V1.2	101 168 01 ... 36
PCB Control CS_CI	388 032 67 P, sheet 1/10 ... 10/10 388 032 67 R, sheet 1
PCB Control CS_C	388 032 68 R, sheet 1
PCB Battery Charge CS_CI	388 032 90 P, sheet 1 388 032 90 R, sheet 1
PCB Modem Supply CS_M	2000772-001, sheet 1 (P-Plan) 2000771-002, sheet 1 (R-Plan)

Copyright GE Medical Systems IT, Schutzvermerk nach DIN 34 beachten

423 203 59

504 660 53
scr DIN7985 M3x6
(801 776 31)

432 522 13
scr f. plastic 3x10 countersunk
(801 777 00)

wshr DIN 471-6x0,7 (2x)
(804 177 24)

432 522 29
in 01,02,05...11,15,17,19,21,22,25...32,34...38
scr f. plastic 3x14 countersunk
(801 777 17)

432 522 09
scr f. plastic 3x12 panhead (2x)
(801 777 08)

432 522 34
scr f. plastic 3x10 countersunk
(801 777 00)

432 522 12
in 01,02,05...11,15,17,19,21,22,25...32,34...38
scr f. plastic 2,2x8 panhead (2x)
(801 777 14)

432 526 11

ⓔ 2001495-001
in 23,24,33

504 657 74
scr DIN7985 M3x6 (2x)
(801 776 31)

388 029 10

19 927 230 26
auf Unterseite geklebt
glued on underside

416 118 19 2x

925 096 31 2x

416 118 18

504 657 25

432 522 10
scr f. plastic 3x12 panhead (2x)
(801 777 08)

scr DIN7985 M3x6 (801776 31)
wshr DIN128 A3 (804 177 18)
unter Schraubenkopf
under screw head
wshr DIN6798 A3,2 (804 082 00)
zwischen Kabelschuh und Druckbalken
between cable lug and press bar

17 430 036 00

432 525 71
scr f. plastic 3x12 panhead
(801 777 08)

ⓓ 2007355-001
scr f. plastic 2,5x6 panhead (4x)
(801 777 31)

388 032 90
scr DIN7985 M3x6
(801 776 31)
in 01,02,05...10,21...38

927 228 94 16
in 23,24,33

432 525 65
scr DIN7985 M3x8
(801 776 40)

504 657 24
in 01,02,05...11,15,17,19,21,22,25...32,34...38

2000771-001
in 23,24,33
scr DIN7985 M3x6 (2x)
(801 776 31)

9 Sicherung
Fuse/Fusible
SI 1 TRS T2A

M 2:1

wshr DIN6798 A4,3
(804 083 00)

scr DIN7985 M4x10
(801 776 35)

wshr DIN128 A4
(804 125 00)

916 118 00

432 525 66

432 525 53

432 525 67
mit Sicomet 50 in Gehäuseunterteil geklebt
glued with Sicomet 50 on casing base

432 525 64
scr DIN7985 M3x8
(801 776 40)

416 118 49

419 118 48

416 118 22

421 032 54 2x

432 521 92 2x

in 02,06,08,10,22,26,28,30,35,36,38

303 442 91

923 096 84

388 031 25

383 273 27

923 096 65

927 228 48
scr DIN7985 M3x6 (3x)
(801 776 31)

388 032 67 in 21...38
388 032 68 in 01,02,05...11,15,17,19
scr DIN7985 M3x6 (6x)
(801 776 31)

432 521 91
pin ISO 2338-B-4x24 (2x)
(805 124 16)

Gehäuseoberteil
casing upper shell

432 525 55 GE Medical Systems

423 203 58

432 525 69
geklebt mit Sicomet 50
glued with Sicomet 50

419 070 87
abgedeckt mit
covered with
927 230 27 170 lang
length 170

430 514 59 13
in Gehäusemitte aufgeklebt
glued in the middle of the casing
in 23,24,33

929 166 45
929 166 48
929 166 54
in 02,06,08,10,22,26,28,30,35,36,38

Bohrung in Gehäuseoberschale gestanzt
bore hole punched into the casing upper shell

432 525 59 (MAC 1100), in 01,02,05...11,15,17,19
432 525 60 (MAC 1200), in 21...30,34
432 525 61 (MAC 1200 ST), in 31...33,35...38

390 002 00 inter1; in 01,02,11,21,22
390 002 01 inter2; in 05,06,09,10,15,19,25,26,29,30
390 002 02 USA; in 23,24
390 002 03 russ; in 07,08,17,27,28
c 2005766-001 int1; in 31,35
2005767-001 int2; in 32,36
2005768-001 USA; in 33
2005769-001 jpn; in 34
2006714-001 rus; in 37,38

432 521 99

303 442 72

432 522 11
geklebt
glued

ⓔ 923 096 61
in 01,02,05...11,15,17,19,21,22,25...32,34...36 (1x20mm)
in 23,24,33 (2x20mm)

ⓔ 2001495-001

303 442 71

415 154 39 4x
symmetrisch montiert
assembled symmetric

504 657 26
scr DIN965 M3x8 (2x)
(841 550 42)

432 525 78
scr DIN7985 M4x40 special shaft (4x)
(801 776 86)
scr DIN7985 M4x20
(801 776 36)

504 660 52
scr f. plastic 3x12 panhead (5x)
(801 777 08)

432 521 98

504 657 60
in 23,24,33

423 203 27
scr DIN7981 ST 2,2x4,5
(801 776 73)

927 229 55 15
in Batteriefach geklebt
glued into battery compartment

829 074 08 70 lang (2x)
length 70 (2x)
ca. 130mm Abstand, mittig
in Batteriefach geklebt
approx. 130mm distance, glued
symmetric into battery compartment

303 442 70
in 01,02,05...10,21...38

Gehäuseoberteil, Ansicht von innen
casing upper shell, view from rear
M 1:2

927 230 38

480 159 69
Greifring G2x0,6 (804 107 00)
lock ring

432 525 72

h 2008125-001
Motor von innen montiert
motor mounted from rear
scr f. plastic 2,5x10 panhead (2x)
(801 777 27)

925 096 36

925 093 00

480 159 66
Greifring G2x0,6 (804 107 00)
lock ring

480 159 67

BH für alle Zahnräder
for all gear wheels

Haube 432 522 13 abgenommen
cover 432 522 13 removed

927 230 20 01 02 03 04
siehe Beschilderungsblatt
see labels catalog
ⓓ

927 230 20 14
in 23,24,33

430 518 20 12
in 23,24,33

924 017 14 4x

CAUTION:
US Federal law restricts this device to sale by
or on the order of a physician

423 203 60

930 118 58
scr f. plastic 2,5x8 panhead (4x)
(801 777 20)

430 501 00 11
in 23,24,33

Sicherungen / fuses:
912 084 49 (2x) T 1,25 A

Hierzu: Drahtsatz
also see: wire set
383 273 99
383 274 09 in 101 168 02,06,08,10,22,26,28,30,35,36,38
2001795-001 in 101 168 23,24,33

GE Medical Systems IT GmbH	h	1x	068588	390 447 44 changed in 2008125-001	20.12.2001	B.Deimel
Munzinger Str. 3	g	1x	067972	Text auf Etikett Nr. 16 geändert	18.09.2001	B.Deimel
D-79111 Freiburg	f	--	067693	Steckergehäuse 975.434.82/86 + 975.416.21 in 383 273 99	03.09.01	G.Krieg
Werkstoff - Material	e	3x	067374	Sach-Nrn. geändert, Sach-Nr. hinzu	03.07.2001	B.Deimel
	d	2x	066928	Sach-Nr. u. Schrauben geänd., Schild 02, 04, Var.24 hinzu	05.06.2001	B.Deimel
	c	4x	066614	Var. 31..38 u. Sach-Nrn. hinzu, Text geänd.	18.04.2001	B.Deimel
Rohteil	b	3x	064150	Sach-Nr. und Text hinzu, Sach-Nr. berichtigt	30.11.99	Deimel
	a	--		neu	02.11.99	Deimel
	Ersetzt durch / ersetzt für Nr.		ECO No.	Änderungsbeschreibung - Change Description	Datum - Date	Name
Freimaßtoleranz - Tolerance	Projektion		Format	Maßstab - Scale	Oberfläche - Finish	Datum - Date	Name
			A0	1:1		Erstellen-Datum	06.12.98	Deimel
File Name: 10116801-D01_ZM01						Geprüft-Agreed	02.11.99	Deimel
Dokument Bezeichnung - Document Description: doc mech dwg ZM01						Geprüft-Agreed		
Dokument Nr - Document No.: 10116801-D01	Dacho.Art/Blatt Nr		Teil Bezeichnung - Part Description			Teil Nr - Part Number		
	ZM/01		MAC 1100 / 1200 / 1200ST			101 168 01...38		

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Gerätestecker
Power Plug
915 419 36

Sicherungen
Fuses and ratings
2 x T 1,25 A 912 084 49

Netzteil
Power Supply
930 118 58

Display 2007355-001 (f)

(c) PCB Modem Supply CS_M
2000771-001
in 101 168 23,24,33

(d) Drahtsatz
Wire Set
2001795-001
in 101 168 23,24,33

Chassis
504 660 52

303 442 71
930 116 87

Druckbalken
Press Strip
504 657 26

Thermokamm 216 mm
Thermal Array Printhead 216mm

Lpl Kammverbindung
PCB Printhead Connection
388 029 10

Motor
303 447 76

Markenleser 303 438 29
Mark Reader
in 101 168 23,24,33

oder/or Sensor opt 2001495-001 (g)
in 101 168 23,24,33

915 416 21 (d)
915 414 86
915 414 82

Markenleser 303 438 29 (b)
Mark Reader

oder/or Sensor opt 2001495-001 (g)

Lpl Pumpenhalter
PCB Pump Holder
388 031 25
in 101 168 02,06,08,10,22,26,28,30,35,36,38

Pumpenmodul
Pump Modul
303 442 91

383 274 09
in 101 168 02,06,08,10,22,26,28,30,35,36,38

Lpl Steuerung CI
PCB Control CI
388 032 67
in 101 168 21...38

Lpl Steuerung C
PCB Control C
388 032 68
in 101 168 01,02,05...11,15,17,19

Lpl Akku-Ladung
PCB Battery Load
388 032 90
in 101 168 01,02,05...10,21...38

Batterie
Battery
303 442 70
in 101 168 01,02,05...10,21...38

Akku 18V 1,4Ah
929 166 37

Motor
303 447 46

MOTOR/
388 032 67 up to Rev. H
388 032 68 up to Rev. G

(h) Motor
2008125-001

MOTOR/
388 032 67 from Rev. I
388 032 68 from Rev. H

Tastatur
Keyboard

MAC 1100/1200
- 390 002 00 (INT1) in 101 168 01, 02, 11, 21, 22
- 390 002 01 (INT2) in 101 168 05, 06, 09, 10, 15, 19, 25, 26, 29, 30
- 390 002 02 (USA) in 101 168 23,24
- 390 002 03 (RUS) in 101 168 07, 08, 17, 27, 28

(e) MAC 1200 ST
- 2005766-001 (INT1) in 101 168 31, 35
- 2005767-001 (INT2) in 101 168 32, 36
- 2005768-001 (USA) in 101 168 33
- 2005769-001 (JPN) in 101 168 34
- 2006714-001 (RUS) in 101 168 37, 38

Hierzu / also see:
Drahtsatz / wire set:
383 273 99
383 274 09 in 101 168 02,06,08,10,22,26,28,30,35,36,38
(c) 2001795-001 in 101 168 23,24,33

h	1x	068588	new stepper motor	21.01.2002	B.Deimel
g	2x	067374	Sensor opt. hinzu	03.07.2001	B.Deimel
f	1x	066928	Sach-Nr. geändert, Variante 24 hinzu	06.06.2001	B.Deimel
e	1x	066014	Var. 31 bis 38 und Sach-Nrn. hinzu	20.04.2001	B.Deimel
d	2x	066241	2x Item No. hinzu	05.01.01	G.Krieg
c	2x	064159	Lpl und Text hinzu	30.11.99	Deimel
b	1x	061952	Text entfallen	12.04.99	Deimel
a		neu		08.03.99	Deimel

GE Medical Systems IT GmbH
Munzinger Str. 3
D-79111 Freiburg

Werkstoff - Material

Rohteil

Entw.: N.Schnurr

Änd.Index Revision | Anzahl vor Nachtrag | ECO No. | Änderungsbeschreibung - Change Description | Datum - Date | Name

Freimaßtoleranz - Tolerance

Projektion | Format A1 | Maßstab - Scale 1:1 | Oberfläche - Finish

	Datum - Date	Name
Entworfen-Drawn	07.12.98	Deimel
Geprüft-Approved	17.12.98	N.Schnurr
Geprüft-Approved		

File Name: 10116801-D03_SZ

Dokument Bezeichnung - Document Description: doc schem SZ01

Dokument Nr. - Document No.: 10116801-D03

Zeichn.Art/Blatt Nr.: SZ/01

Teil Bezeichnung - Part Description: MAC 1100 / 1200 / 1200 ST

Teil Nr. - Part Number: 101 168 01...38

Diese Tabelle definiert die gültigen Konfigurationen des MAC 1100/1200/1200ST Version 1.2
This table defines the valid configurations of the MAC 1100/1200/1200ST Version V1.2

Komponente / Component			Sach-Nr. / Part No.	Index (Prod.)	Referenz / Reference	kompatibel(Service) / Compatible(Service)	in Variante / in Device Variation
Steuerung CS_C	Lpl Steuerung CS_C	PCB Control CS_C	388 032 68	H		B,C,D,E,G	01,02,07...11 17,19
	Ersatzteil-Nr.	Spare Part No.	2000070-002				
	Austausch Nr.	Replacement No.	2000071-002				
Steuerung CS_CI	Lpl Steuerung CS_CI	PCB Control CS_CI	388 032 67	I		C,D,E,F,H	21...24 27...38
	Ersatzteil-Nr.	Spare Part No.	2000072-002				
	Austausch Nr.	Replacement No.	2000073-002				
Akku-Ladung CS_CI	Lpl Akkuladung CS_CI	PCB Battery Charge CS_CI	388 032 90	D		B,C	01,02,07...10 21...24,27...38
	Ersatzteil-Nr.	Spare Part No.	-				
	Austausch Nr.	Replacement No.	-				
Netzteil Power Supply	Lpl SNP-9549-MH	PCB SNP-9549-MH	930 118 58	A			01,02,07...11 17,19 21...24,27...38
Remarks Index A :	Skynet Netzteil SNP-9549-MH						
Modem Supply	Lpl Modem Supply CS_M	PCB Modem Supply CS_M	2000771-001	A			23,24,33
	Ersatzteil-Nr.	Spare Part No.	-				
	Austausch Nr.	Replacement No.	-				
Pumpenmodul:			303 442 91	A			
	Lpl Pumpe	PCB Pumpe	388 029 18	B , C			02,08,10, 22,28,30,35,36,38
	Ersatzteil-Nr.	Spare Part No.	-				
	Austausch Nr.	Replacement No.	-				
	MAC 1100 V1.2						01,02,07...11,17,19
	MAC 1200 V1.2						21...23,27...30
	MAC 1200 ST V1.2						31...38
Software MAC 1100							
	Software Code SW_MAC 1100 V5.2		2000252-005				01,02,07...11,17,19
	Ersatzteil-Nr.	Spare Part No.	2000284-006				
	Austausch Nr.	Replacement No.	-				
Software MAC 1200 / 1200 ST							
	Software Code SW_MAC 1200 V5.21		2000253-006				21...23,27...38
	Ersatzteil-Nr.	Spare Part No.	2000285-007				
	Austausch Nr.	Replacement No.	-				

GE Medical Systems IT GmbH
Munzinger Str. 3
D-79111 Freiburg

Änd.Index Revision	kommt vor numbers	ECO No.	Änderungsbeschreibung - Change Description	Datum - Date	Name
l	-	068588	388 032 67 von H auf I, 388 032 68 von G auf H	21.01.2002	B.Deimel
k	-	067494	388 032 67 von F auf H, 388 032 68 von E auf G	01.08.2001	B.Deimel
j	-	067169	Variante 24 hinzu	06.06.2001	B.Deimel
i	-	066014	MAC 1100/1200 V1.2, SW 5.2	17.04.2001	B.Deimel
h	-	066534	Index bei 388 029 18 von B auf C	05.03.01	Koch
g	-	064150	MAC1100/1200 V1.1	11.01.00	G.Kaltenbach
f	-	063901	Schutzschaltung V9	13.12.99	G.Kaltenbach
e	-	062727	Software Release V5.02	08.07.99	G.Kaltenbach

Werkstoff - Material

Rohteil

Freimaßtoleranz - Tolerance

File Name: 10116801-D04_SZ02

Dokument Bezeichnung - Document Description: doc schem SZ02

Dokument Nr. - Document No.: 10116801-D04

Projektion

Format: A4

Maßstab - Scale: 1:1

Oberfläche - Finish

	Datum - Date	Name
Entworfen-Drawn	08.03.99	G.Kaltenbach
Geprüft-Approved	08.03.99	N.Schnurr
Geprüft-Approved		

Zeichn.Art/Blatt Nr.: SZ/02

Teil Bezeichnung - Part Description: Master Record Index MAC 1100/1200/1200ST V1.2

Teil Nr. - Part Number: 101 168 01..38

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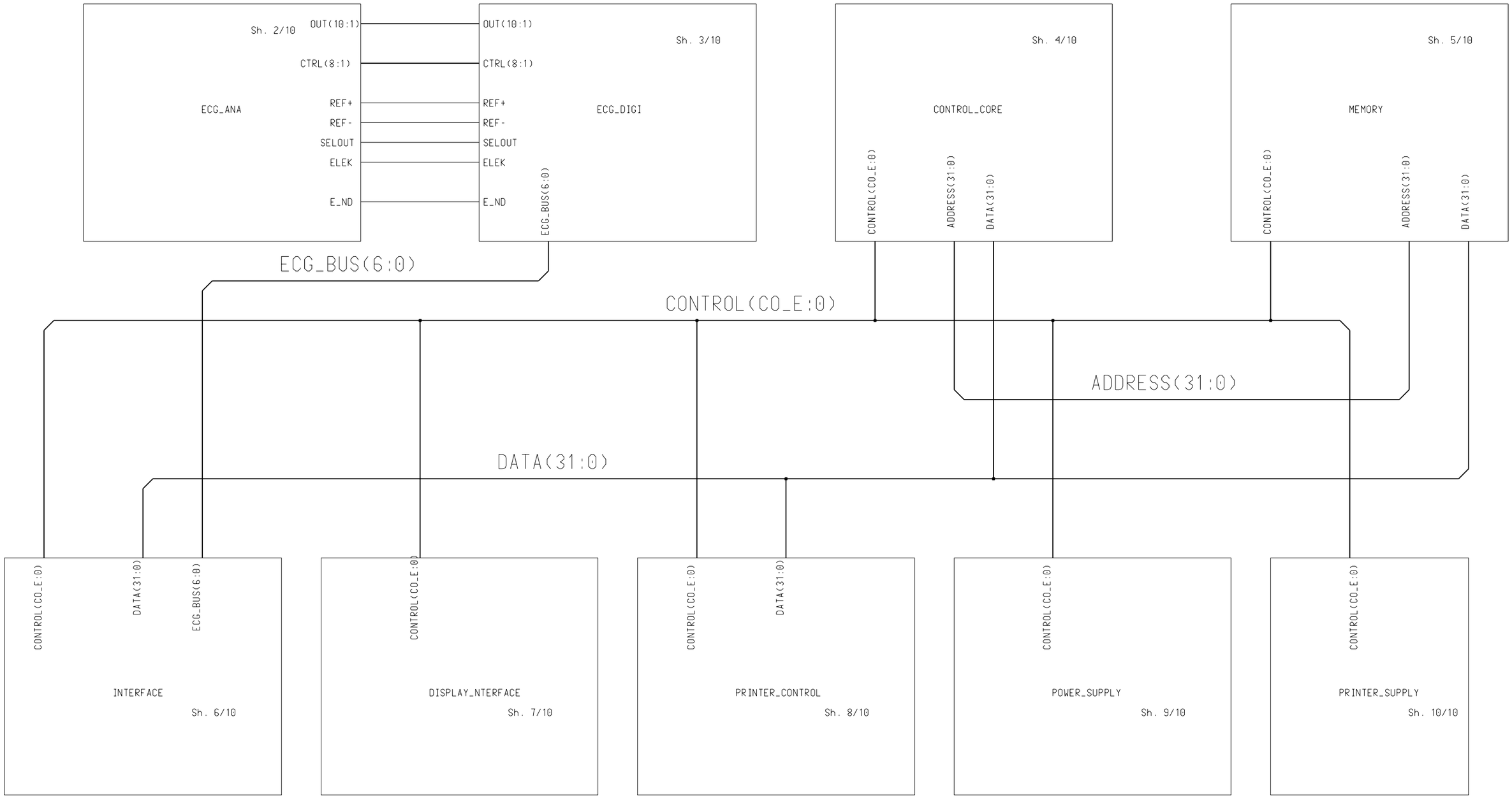
Schutzvermerk nach DIN 34 beachten



Schutzvermerk nach DIN 34 beachten

Marquette Hellige GmbH D-79007 Freiburg						388 032 67 -D01 Sheet: 1 of 10
Not equipped in Version :		REVISIONS Revision-No	Index	Date / Name	A03	F67252
x1	388 032 67	------	A	25.09.98/NTS		Date / Name
x2	388 032 68	ECO-062920	B	13.01.00/NTS	DRAWN	12.02.98 / NTS
x3		ECO-065096	C	26.03.01/MLB	APPROVED	09.03.98/NTS
x4						
x5					ISSUED	N. SCHNURR
						SCHEMATIC STEUERUNG CS_CI

[1997, 8, 11, 2]
$USER_CAE_B/cardiosmart_ci/design

27P
x1 x2
CX1
integrated CKT BD Capacitor

EKG/10 L
EKG/11 F
EKG/12 C1
EKG/1 C2
EKG/2 C3
EKG/3 C4
EKG/4 C5
EKG/5 C6
EKG/15 Nax
EKG/13 Nst
EKG/9 R
EKG/14 N
EKG/6
EKG/7
EKG/8

MMBD1503A D44 D46 D48 D41 D43 D45 D47 D49 D56 D50 D42 D53

47K5 R363 R383 R396 R373 R406 R421 R415 R428 R459 R440 R434 R450

120M R372 R395 R405 R382 R414 R427 R420 R433 R458 R449 R439

24K3 R390

4u7 L73 L72 L83 L82 L75 L76 L77 L78 L79 L81

BZV55C5V6 D87 D88

0R R647

x1, x2 R641 10K

100K R345 R324

2K21 R338

17K8 R313

AGND AVSS AVDD

TLC2264CD V17 V18 V20 V16

100n C173 C176 C291 C292 C293 C294 C295 C296 C298 C300 C301 C195 C199 C226 C225 C221 C297 C164 C162

100p C172 C182 C177 C171 C194 C200 C208 C191 C229 C222

68K1 R404 R447 R432 R391 R463 R532 R531 R464 R574 R541 R511

24K3 R431 R438 R388 R478 R515 R524 R448 R575 R548

47K5 R799

10P C303

R540 24K3

1n C166 C168 C169 C179 C183

150K R364 R377 R387 R435 R443

1n C213 C217 C219 C236 C238

R535 R544 R546 R582 R609

249K R599 R573

0U22 C235

R510 221K

3n3 C228

BAS85 D68

R547 47K5

100K R409 R424 R473 R474 R471 R472 R341 R342

150p C174 C178 C189 C190 C187 C188 C157 C158

100K R556 R566 R630 R631 R628 R629 R506 R507

150p C224 C232 C267 C268 C265 C266 C203 C204

100K R344 R343 R508 R509

150p C159 C160 C205 C206

100n C156 C170 C261 C202 C220 C201

SDM_HEC2 Z28 Z33

IM2A IM2E OUT2A OUT2E REFA REFE OUT1A OUT1E IM1A IM1E IM2B IM1B IM2C IM1C IM2D IM1D OUT2B OUT2C OUT2D REFB REFC REFD OUT1B OUT1C OUT1D AVSS1 AVSS2 AVDD DVDD DVDD1 DVSS SWITCH OUT1 OUT2 OUT3 OUT5 OUT4 RMPP RMPM CLK PDN REFM2 REFM1 REFP2 REFP1

OUT(10:1)

33K2 R470 R626

470P C186 C264

BAS32 D55 D72 D71

18K2 R505 R627

CD4051B MUXDMUX

CTRL(8:1)

Z35

Vcc=AVDD,Ground=AGND,Vee=AVSS

1M R378

100K R359 R365

SELOUT ELEK E_ND REF+ REF-

ECG_ANA

Schutzvermerk nach DIN 34 beachten

Marquette Hellige GmbH D-79007 Freiburg						388 032 67-D02	Sheet: 2 of 10
Not equipped in Version :		REVISIONS Revision-No	Index	Date / Name	A03	F67252	
x1	388 032 67	---	A	04.02.99/HTW		Date / Name	SCHEMATIC
x2	388 032 68	ECO-062920	B	13.01.00/NTS	DRAWN	12.01.99/HTW	
x3		ECO-065096	C	26.03.01/MLB	APPROVED	09.03.98/NTS	STEUERUNG CS_CI
x4							
x5					ISSUED	H. WEBER	

[1997, 8, 11, 2]
$USER_CAE_B/cardiosmart_ci/control_ci/design/ecg_ana

OUT(10:1)

CTRL(8:1)

DIGI_HEC2

CIN1 CIN2 CIN3 CIN5 CIN4 CIN6 CIN7 CIN8 CIN10 CIN9 SWITCH OP1 OP2 OP3 OP4 PL1 PL2 PL3 INP1 INP2 INP3 INP4 RESP

SCLK MOSI KARDMON EXTVEN RESETIN NCSO* MISO OSCIN OSCOUT CLKIN DVSS DVDD TSYNC PACE2 PACE1 PDNOUT CLKOUT RESOUT

Z22

MAX809LEUR X14 RESET_ VCC GND +5VF C306 100n GNDF

4.096MHz QU2 G165 22p C181 22p

100n C227 100n C163

DVSS DVDD

4K75 R659 DVDD

0R R836

R389 30R1 22p C167 GNDF

+5VF

R242 1K R241 1K R240 1K R239 1K

HCPL2630 X10 X9 X11

100n C138 100n C137

R222 475R SPICKL_

R221 475R SPIMOSI_

R219 475R HEC_CS0

R244 475R GNDF

R243 475R

L84 1u6 HEC_MISO_

L85 1u6 TSYNC_

1K 100n C124 R224 R223 1K

L66 0u1 +5V

C117 C123 C122 C120 C114 C125 100p x1,x2

ECG_BUS(6:0)

10K R844 R843 R842 R841 R840 R246 R248 R838 R311 R292 R288 R839

PIC16C72A Z21

RB0 RB1 RB2 RB3 RB4 RB5 RB6 RB7 RC0 RC1 RC2 RC3 RC4 RC5 RC6 RC7

VDD VSS1 VSS2 MCLR OSC1 OSC2 RA0 RA1 RA2 RA3 RA4 RA5

R247 10K R255 10K R845 10K +5VF

ELEK

SELOUT

R571 30K1 R570 0R GNDF

1n5 C233

LMC6484IM V22 AVSS AVDD

30K1 R617 0U22 C240

R577 1K R567 30K1

R633 21K5 R632 4K32

R538 18K2 R479 150K R468 4K75 AVDD

R498 49K9 LM339D V19

R455 4K75 BAS85 D52

R493 10K R492 47K5

R529 24K3 R514 16K2

R456 4K75 BAS85 D51

REF+ REF-

BAS32 D59 10K R551 AVDD

REF+ R622 100R LMC6484IM 15n C241

1U C239 AGND

R611 10K R552 1K87

15n C231 R579 10K R550 19K6

100n C270 AVDD

R578 100R R601 10K

0U47 C214 0U47 C215

100n C230 AVSS LMC6484IM V22

TL431ACD [SHUNTREG] +[2,5V] 0V V21

AGND 1U C223

E_ND

475K R803 100n C302 AGND LM339D V19

R801 22K1 R453 10M R457 4K75 BAS85 D38

47K5 R800 AVDD

AVSS 22K1 R802 10M R491 4K75 R467 BAS85 D39

100n C207 AGND R496 475K

R477 4K75

DVSS AGND GNDF

DVDD +5VF

AVDD

AVSS -5VF

74HCT14 Z12

74HCT14 Z12 GND

TL750L05CD VREG V15 V14 5V GND +5VF

BZV55C5V6 D90 D89 x1,x2

47U C146 47U C145

100n C140 100n C141

220U C153 220U C151

BAS85 D37 D36

100n C148 100n C147

1K R272 1K R250

100p C150 100p C139

-5VF

Tr1 S1 S2 W1 W2 W3

100n C118 100n C116

R218 2K21 BAS85 D34

68M R238 100p C119

T24 IRLR024

R226 332R

74HCT14 Z12 74HCT14 Z12 74HCT14 Z12

470U C112 10u L64 +5V

470p C113 F125KHZ

100K R205 BAS85 D35 10u L63 GND

ECG_DIGI

Schutzvermerk nach DIN 34 beachten

Marquette Hellige GmbH D-79007 Freiburg						388 032 67-D03	Sheet: 3 of 10
Not equipped in Version :		REVISIONS Revision-No	Index	Date / Name	A03	F67252	
x1	388 032 67	------	A	17.09.98/NTS		Date / Name	SCHEMATIC
x2	388 032 68	------	B	04.02.99/NTS	DRAWN	12.01.99/HTW	STEUERUNG CS_CI
x3		ECO 062920	C	13.01.00/NTS	APPROVED	09.03.98/NTS	
x4		ECO 065096	D	26.03.01/MLB			
x5					ISSUED	H. WEBER	

[1997, 8, 11, 2]
$USER_CAE_B/cardiosmart_ci/control_ci/design/ecg_digi

MPC821

Z24

Vcc=+3.3V

Clock Generator

Reset Configuration

WatchDog

CONTROL CORE

Schutzvermerk nach DIN 34 beachten

Marquette Hellige GmbH D-79007 Freiburg	388 032 67-D04
	Sheet: 4 of 10
SCHEMATIC	
STEUERUNG CS_CI	

Not equipped in Version :	Revision-No	REVISIONS Index	Date / Name	A03	F67252
x1 388 032 67	-------	A	25.09.98/NTS		Date / Name
x2 388 032 68	-------	B	04.02.99/NTS	DRAWN	25.02.98/NTS
x3	-------	C	02.03.99/NTS	APPROVED	09.03.98/NTS
x4	ECO-062920	D	13.01.00/NTS		
x5				ISSUED	N. SCHNURR

[1997, 8, 11, 2]
$USER_CAE_B/cardiosmart_ci/control_ci/design/control_core

ECG SRAM buffered

BOOT FLASH, lower
Organisation x32

BOOT FLASH, upper
Organisation x32

FLASH 1, lower
Organisation x32

FLASH 1, upper
Organisation x32

DRAM 1, lower
Organisation x32

DRAM 1, upper
Organisation x32

Vcc=+3.3V
AM29LV800BB-90EC

Vcc=+3.3V
HM51W16165

Vcc=+3.3VSRAM
TC554161FTL-70V

ADDRESS(31:0)
CONTROL(CO_E:0)
DATA(31:0)

Option Serial EEPROM
X24165

Option Serial RTC
RTC8593SA

MEMORY CONFIGURATION

Memory Configuration Bit
"DRAM_32B" = "Low"
indicates
Hardware Version V1.1

MEMORY

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Not equipped in Version :		REVISIONS Revision-No	Index	Date / Name	A03	F67252
x1	388 032 67	------	A	25.09.98/NTS		Date / Name
x2	388 032 68	ECO-062920	B	13.01.00/NTS	DRAWN	04.03.98 / NTS
x3		ECO-065096	C	30.11.00/MLB	APPROVED	09.03.09/NTS
x4		ECO-068588	D	09.01.02/SNA		
x5					ISSUED	N. SCHNURR

SCHEMATIC
STEUERUNG CS_CI

Schutzvermerk nach DIN 34 beachten

[1997, 8, 11, 2]
CS

CONTROL(CO_E:0)

CONTROL/STATUS REGISTER

74ABT16374 Z32 · 74HCT14 Z23 · 74LVC32 Z29 · 74LVC16244 Z30 · 74HCT14 Z9 · 74HCT125 Z7 · 74HCT14 Z6

REG_ON_ · DEV_OFF · REG_ON · LOAD_OFF · LED_BATT_ · LCD_HSEL · LCD_VSEL · DISP_OFF_COSEL · LCD_ENBA · CS_KBSTCR_ · WE0_IORD · EN_KBSTCR_ · CS_KBSTCR_ · WE1_IOWR · EN_KBSTCR_

BATT_LEV1 · BATT_LEV2 · BATT_OPT_ · KB_CONF1 · DRAM_32B · FLASH_WS_ · RAM_BUFF_ · RBUFF_WS_ · KB_CONF2 · DISP_CONF1 · DISP_CONF2 · TPC_CONF

KEYBOARD INTERFACE

KB_CONF2 · KB_CONF1 · ONOFF_SW_

KEYB/ 1 · KEYB/ 2 ON_OFF · KEYB/ 19 KB_CONF1 · KEYB/ 21 KB_CONF2

KEYB/ 3 COL 1 · KEYB/ 5 COL 2 · KEYB/ 7 COL 3 · KEYB/ 8 COL 4 · KEYB/ 10 COL 5 · KEYB/ 11 COL 6 · KEYB/ 12 COL 7 · KEYB/ 13 COL 8 · KEYB/ 14 NC

KEYB/ 4 ROW 1 · KEYB/ 6 ROW 2 · KEYB/ 9 ROW 3 · KEYB/ 15 ROW 4 · KEYB/ 16 ROW 5 · KEYB/ 17 ROW 6 · KEYB/ 18 ROW 7

KEYB/ 24 LED_LIN · KEYB/ 25 LED_STOP · KEYB/ 26 LED_START · KEYB/ 20 LED_GND · KEYB/ 22 LED_SUPPLY · KEYB/ 23 LED_BATT

RS232 INTERFACE

Enable Modem Supply · EN_MOSU · ADM202EARU Z4 · SMBJ15C D92 · BAS85 D93 · BC847B T34

TXD1 · RXD1 · DTR1 · RTS1_ · CTS1_ · CD1

RS232/1 CDE · RS232/2 RXDE · RS232/3 TXDE · RS232/4 DTRE · RS232/5 GND · RS232/6 V_MODEM · RS232/7 RTSE · RS232/8 FERNST/CTSE · RS232/9 EKGTRIG · RS232/ 10 · RS232/ 11

FERNST · EKGTRIG

OPTION RS232 EXTENSION

RXD2 · TXD2 · SMRXD1 · SMTXD1 · TFDS3000 X8 · Option IRDA

RS232_E/ 1 · RS232_E/ 2 · RS232_E/ 3 · RS232_E/ 4 · RS232_E/ 5 · RS232_E/ 6 · RS232_E/ 7 · V_MODEM RS232_E/ 8 · EKGTRIG_E RS232_E/ 9 · FERNST_E RS232_E/ 10

DATA(31:0)

ECG_INTERFACE

ECG_BUS(6:0) · F125KHZ · CLK_FLOAT · CLK_ASIC · SPICLK_ · SPIMOSI_ · HEC_MISO_ · TSYNC_ · HEC_CS0 · SPICLK · SPIMOSI · SPIMISO · EKG_INT_

LINE_ON · LED_LIN · LED_START · LED_BATT_ · SPEAKER

BUZZER

FTCW05 LS1 · BC847B T23

ISPLSI1016 Z13 · CLK_FLOAT · Q1_PWM · Q2_PWM · Q3_PWM · Q4_PWM · Q5_PWM · Q6_PWM · Q7_PWM · EN_TBASE · CLK_ASIC · Q1_TB · ISP_SDO1 · ISP_SDO · ISP_MODE · ISP_EN_ · CLKOUT · BHRESET_ · ISP_SCLK · Q2_TB · T_BASE_3 · T_BASE_2 · T_BASE_1 · F500HZ · ENSPI1_ · OEN1_ · Q0_SPI1 · Q1_SPI1 · Q2_SPI1 · Q3_SPI1 · ENSPIHEC_ · BHRESET_ · ENSPI2_ · ENSPI2L_ · SPICLK2L · Q0_AD · Q1_AD · Q2_AD · Q3_AD · FLOAT_SW

Schutzvermerk nach DIN 34 beachten

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Not equipped in Version :		REVISIONS Revision-No	Index	Date / Name	A03	F67252	
x1	388 032 67	------	B	04.02.99/NTS		Date / Name	
x2	388 032 68	ECO 063901	C	14.12.99/NTS	DRAWN	04.03.98/NTS	SCHEMATIC
x3		ECO 062920	D	13.01.00/NTS	APPROVED	09.03.98/MSG	STEUERUNG CS_CI
x4		ECO 065096	E	30.11.00/MLB			
x5		ECO 067494	F	27.08.01/TYR	ISSUED	N. SCHNURR	

[1997, 8, 11, 2]
$USER_CAE_B/cardiosmart_ci/control_ci/design/interface

LCD_BUS(15:0)

1/4 VGA COLOR KYOCERA

DISPLAY DRIVER

74ABT16244 Z8 — LCD_D0..D3 → BLCD_D0..D3
74ABT16244 Z8 — LCD_D4..D7 → BLCD_D4..D7
74ABT16244 Z8 — LCD_D8, LCD_AC_OE, LCD_FRAME, LCD_LATCH → BLCD_D8, BLCD_AC_OE, BLCD_FRAME, BLCD_LATCH
74ABT16244 Z8 — LCD_CLK, LCD_ENBA, DISP_OFF_COSEL, LCD_CONTR → BLCD_CLK, BLCD_ENBA, BDISP_OFF_COSEL, BLCD_CONTR

BLCD_FRAME, BLCD_LATCH, BLCD_CLK, BDISP_OFF_COSEL, BLCD_D1..D8 → 955n L25..L46 x2 → KYO/ 1 .. KYO/15

KYO/ 1 → TFT/ 4
KYO/ 2 → TFT/ 3
KYO/ 3 → TFT/ 2
KYO/ 4 → TFT/ 6, TFT/13, TFT/20
KYO/ 5 → TFT/10
KYO/ 6 → TFT/ 9
KYO/ 7 → TFT/18
KYO/ 8 → TFT/17
KYO/ 9 → TFT/16
KYO/10 → TFT/24
KYO/11 → TFT/23
KYO/12 → TFT/22
KYO/13 → TFT/27, TFT/28
KYO/14 → TFT/ 1, 5, 7, 8, 12, 14, 15, 19, 21, 25
KYO/15 → TFT/ 1, 5, 7, 8, 12, 14, 15, 19, 21, 25

LCD_BUS(15:0) → 955n x1,x2 L47 → TFT/ 11
LCD_AC_OE → 955n x1,x2 L24 → TFT/26
LCD_HSEL → 955n x1,x2 L23 → TFT/29
LCD_VSEL → 955n x1,x2 L22 → TFT/30

VGA TFT COLOR

1/4 VGA MONOCHROME HOSIDEN

V0, VEE
BLCD_D5 → 955n L60
BLCD_D6 → 955n L59
BLCD_D7 → 955n L58
BLCD_D8 → 955n L57
BLCD_AC_OE → 955n L56
BLCD_CLK → 955n L53
BLCD_LATCH → 955n L52
BLCD_FRAME → 955n L51
BDISP_OFF_COSEL → 955n L50

OR R730 → HOS/ 1
OR R731 → HOS/ 2
L60 → HOS/ 3
L59 → HOS/ 4
L58 → HOS/ 5
L57 → HOS/ 6
L56 → HOS/ 7
OR R732 → HOS/ 8
OR R733 → HOS/ 9
L53 → HOS/10
L52 → HOS/11
L51 → HOS/12
L50 → HOS/13
HOS/14

OR R734, OR R735 → GND; x1,x2

Displ. Recognition

CONTROL(CO_E:0)
DISP_CONF2: +3.3V, R539 10K, R542 221R, GND
DISP_CONF1: +3.3V, R676 10K, R692 221R, GND
BHRESET
"L" = monochrome
R186 475R → GND
74HCT14 Z12 (1, 2)
+5V, 0U1 C111, GND
BLCD_CONTR

ENABLE "L" = enable

47K5 R121
T10 BC847B, 47K5 R125, 0U1 C75, D28 BAS32, 1M R144
0U1 C90
0U47 C84, 0U47 C83, R124 4K75, 10N C88
100p C82
R99 0R, +5V
Strombegrenzung
LT1172CS8 X7 (GND, VC, FB, E2, VSW, E1, VIN)
R148 1K, L44 470u, BYM12-150 D24
R136 1R, 499R R145, 100K R736, T19 BC807-25, ZMM4.7 D29, D30 BAS32, R162 2K43
0U1 C74, 20K0 R700, 4u7 C81, R155 20K0, R151 1K, C94 1n
+26V
T31 BC847B
R701 33K2, R702 33K2
0U1 C69, 47U C70
R160 1K
OR R122
OR R100, OR R98
GND24V
GNDIGD, GNDN, GND
BLCD_ENBA

+26V SWITCHING REGULATOR

BACKLIGHT ON/OFF

+5V, 0u1 L13
0U1 C18, 68K1 R12, IRF7416 T1, 1AF SI1
R18 1K, T20 BC847B, R181 4K75, 3K32 R172
GND, GNDBL

INVERTER BACKLIGHT

solder connection
LOET1
CXA-K10A X3 (+VIN, -VIN, OUT1, OUT2, COM)
0U1 C1
L1 0u1
HOSIDEN BACKLIGHT INTERFACE
HOS_BL/1 CFL_HOT
HOS_BL/2
HOS_BL/3
HOS_BL/4 CFL_GND

BLCD_CONTR
x2 SHARP_BL/1 +5V CFL
x2 SHARP_BL/2 GND CFL
x2 SHARP_BL/3 CONTR CFL
x2 SHARP_BL/4
KYOCERA and SHARP BACKLIGHT INTERFACE
47U C21 x2, GNDBL

-23V GENERATION

Temperature Compensation
R195 5K76, R194 301K, R201 100K, 2k R182, V12 LMC6482IM
R197 100K, R187 365K, 0U47 C107, R192 2M2, R193 33K2
R171 3K92, 0U1 C115, GNDNA
4u7 C80, BAS32 D18, BC807-25 T32, 332R R689, 2R2 R699, 100K R703, x1,x2
BAS32 D22, BC857B T22, 681R R698
R184 1M5, R191 1M5
BLCD_CONTR Z6 (11, 10) 74HCT14
x1,x2 R174 2M2, x1,x2 R185 100K, +5V, x1,x2 R173 100K
R170 10K, BC857B T21
R183 316K
GNDO
0U1 C98, 4u7 C92, R178 68K1, 35K7 R176, 1n C101, 0U1 C100, R159 0R, GND
R177 28K7, V10 LM358D
23R7 R175, 100K R167, x1,x2, LM358D V10, 23R7 R179, x1,x2
VEE, -23V
Z6 (13, 12) 74HCT14, GND
GNDIGD, GNDNA

Schutzvermerk nach DIN 34 beachten

Marquette Hellige GmbH D-79007 Freiburg					388 032 67-D07	Sheet: 7 of 10
Not equipped in Version :		REVISIONS Revision-No	Index	Date / Name	A03	F67252
x1	388 032 67	------	A	25.09.98/NTS		Date / Name
x2	388 032 68	ECO-062920	B	13.01.00/NTS	DRAWN	04.03.98/NTS
x3		ECO-065096	C	30.11.00/MLB	APPROVED	09.03.98/NTS
x4						
x5					ISSUED	N. SCHNURR

SCHEMATIC
STEUERUNG CS_CI

PRINTHEAD INTERFACE

HEATING CONTROL

TEMPERATURE MONITORING

TPC DOT CONTROL

TPC POWER CONNECTOR

MOTOR CONTROL

TPC DATA

MARK READER 1

MARK READER 2

PRINTER CONTROL

CONTROL(CO_E:0)
DATA(31:0)
CPLD(CPLDMAX:0)
ISPLSI1016
74HCT14
74LVC32
IDT7201-35
LM339D
LMC660CM
LM393D
TCA3227G
TL431ACD
BC847B
IRF9024
IRF7301
+5V
+12V
+22.5V
+22.5V_M
+3.3V
+5VREF
GND
ISP/1
ISP/2
ISP/3
ISP/4
ISP/5
ISP/6
ISP/7
ISP/8
ISP/9
ISP/10
CODE
KDATA
KCLOCK
KLATCH
KSTRB
TERM2
MP20
MP21
MP22
MP23
MP24
MARK_RE1
MARK_RE2
REC_START
REC_DIR
RECTMR_STEP
RECTMR_HEAT1
RECTMR_HEAT2
TPC_CONF
REC_OVHEAT_
REC_MOTEN
TPC_PRESS
LOW_SPEED
HEAT
Option Printhead Pressure
COMMON
GNDITPC
VDD1
TPC_PO/6
TPC_PO/5
TPC_PO/4
TPC_PO/3
TPC_PO/2
TPC_PO/1
TPC_DAT/ 12
TPC_DAT/ 20
TPC_DAT/ 18
TPC_DAT/ 16
TPC_DAT/ 1
TPC_DAT/ 13
TPC_DAT/ 15
TPC_DAT/ 17
TPC_DAT/ 19
TPC_DAT/ 14
TPC_DAT/ 3
TPC_DAT/ 4
TPC_DAT/ 5
TPC_DAT/ 6
TPC_DAT/ 7
TPC_DAT/ 8
TPC_DAT/ 9
TPC_DAT/ 10
TPC_DAT/ 11
TPC_DAT/ 2
MR1/ 1
MR1/ 3
MR1/ 4
MR1/ 2
MR1/ 3
MR1/ 2
MR1/ 4
MR1/ 1
MR2/ 1
MR2/ 3
MR2/ 4
MR2/ 2
MR2/ 3
MR2/ 4
MR2/ 2
MR2/ 1
MARK1/ 4
MARK1/ 2
MARK1/ 1
MARK2/ 4
MARK2/ 3
MARK2/ 2
MARK2/ 1
MOTOR/ 6
MOTOR/ 5
MOTOR/ 4
MOTOR/ 3
MOTOR/ 2
MOTOR/ 1
T_PRESS/ 3
T_PRESS/ 2
T_PRESS/ 1

Schutzvermerk nach DIN 34 beachten

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Not equipped in Version :		REVISIONS Revision-No	Index	Date / Name	A03	F67252	
x1	388 032 67	------	B	04.02.99/NTS		Date / Name	
x2	388 032 68	ECO 062920	C	13.01.00/NTS	DRAWN	04.03.98/NTS	SCHEMATIC
x3		ECO 065096	D	13.09.00/MLB	APPROVED	09.03.98/NTS	
x4		ECO 067494	E	27.08.01/TYR			STEUERUNG CS_CI
x5		ECO 068588	F	09.01.02/SNA	ISSUED	N. SCHNURR	

[1997, 8, 11, 2]
$USER_CAE_B/cardiosmart_ci/control_ci/design/printer_control

Interface Power Supply

+24VPS: POSUP/ 1, POSUP/ 2 — L8 0u43 — +24V
GNDPS: POSUP/ 3, POSUP/ 4 — quad ferrite L8 0u43 — GND24V
+24V → STPS340S D1 → +USUPP
STPS340S D2 → +5VSTB

Interface Battery

+24V: BATT/1, BATT/2, BATT/3
BATT/4 Code, BATT/5 NC
GND: BATT/6, BATT/7, BATT/8, BATT/9 → GND24V
x1,x2 470P C3, R3 0R x1,x2 → GND24V
+UBATT: BATT/10, BATT/11, BATT/12, BATT/13
BATT/14 +UBATT_ME
BATT/15 Code
+5V_L: BATT/16 — L2 0u1 — +5V
BATT/17 NC — R495 10K
BATT/18 BATT_OPT_
BATT/19 LOAD_OFF
BATT/20 NC
CONTROL(CO_E:0)

ON/OFF CONTROL

+UBATT_SW → IRFR9024 T2 (1U C288, 100K R5, 68K1 R8) → +USUPPME
STPS340S D4 → +UVERS
STPS340S D3 → +USUPPME
+USUPPME → IRFR9024 T3 → +USUPPSW
100K R21, 100K R28, 1U C289, 0U1 C20, 68K1 R40

+5VSTB: 100K R96, 10K R59, 10K R84, D14 BAS32, 10N C56
CD4093BCM Z3 (GND, +5VSTB, 221R R80)
CD4013BCM Z5 (S VCC, C1, 1D, R GND)
CD4093BCM Z3
+5VSTB: 100K R55, 4K75 R51, 1U C46
CD4093BCM Z3

T29 BC847B, T4 BC847B
R61 22K1, 3K32 R57

ONOFF_SW_

T9 BC847B: R103 4K75, 0U1 C65, 22K6 R118
DEV_OFF
T5 BC847B: R47 10K, R46 10K
T6 BC847B: R76 33K2, 100K R81
REG_OFF_

+24V: R129 1K, D21 BZV55B6V8, D23 BZV55B6V8

Interface Modem Supply

+UVERS: MO_SU/ 1, MO_SU/ 2, MO_SU/ 3
x1,x2 R813 10K → GND24V

+5V SWITCHING REGULATOR

GNDI5V
R48 100R, R39 3K16, R19 100R, 3n3 C23, R27 10K
0U1 C12, 249K R10, x1,x2
+UVERS → R14 0R
LM2595S-ADJ (VIN, ON_OFF, GND, OUT, FB)
L16 47u
x1,x2 4u7 C280, 4u7 C281, x1,x2 220U C4, 0U1 C7, 475R R13
STPS340S D5
100u C35, 100u C25, 0U1 C26
R53 0R → +5V
R62 0R → GND24V
R63 0R → GND
STPS340S D10 → +3.3V

+3,3V SWITCHING REGULATOR

GNDI3V
R44 100R, 3n3 C37, R20 274R, R23 5K76, R33 10K
+UVERS → R70 0R
LM2595S-ADJ (VIN, ON_OFF, GND, OUT, FB)
L19 47u
4u7 C282, 4u7 C283, x1,x2 220U C10, 0U1 C16
STPS340S D6
100u C41, 100u C33, 0U1 C36
R67 0R → +3.3V
R64 0R → GND24V
R65 0R → GND

+ 3.3V STANDBY supply

+USUPP → 5K76 R737
BZV55B6V8 D26, MAX1615EUK-T (VIN, SHDN_, 5_3_, GND, VOUT, V9)
R137 0R, 0U1 C97, 10U C95, 0R R679, x1,x2 R157 100K
4U7 C105
D31 BAS32, D32 BAS32, D33 BAS32, D74 BAS32
4U7 C104 → +3.3VSTB

+ 22,5 V PRINTER SUPPLY

BSS84 T17, 100K R139, 82K5 R142, BAS32 D19
100K R138, T12 BC847B, R120 22K1, 3K32 R141
10K R143, 0U47 C73
ADC0831CCN (CS_, CLK, VCC, GND, VINT+, VINT-, DO, VREF) X6
TL431ACD [SHUNTREG] (+[2,5V], 0V) V6
R110 1K
BATTERY VOLTAGE MONITOR

VOLTAGE CONTROL

+UVERS, +UBATT_SW
20K R686, 20K R25
2K43 R82, 10K R43, 1K R684, 10U C47
LM339D V3 (x4)
10K R83, 10K R54, 3K65 R706, 10U C28
5K49 R42
10K R69, 332R R38, 3K65 R26

OPTION PUMP

+UVERS → D82 BYM10-100 → LM317S VREG (VOUT, ADJ) V23 → 0U1 C55 → GND24V
+UPUMP
R107 4R7, R108 4R7, R106 4R7
BYM10-100 D81, BYM10-100 D80, L35 0u1 NC
PUMP/ 1, PUMP/ 2, PUMP/ 3, PUMP/ 4
L28 0u1 → GND24V
R94 0R

+12V Generation

+UVERS → R161 0R, 0U1 C103
LP2951CM (VIN, FB, VTAP, SHDN, VOUT, SENSE, ERROR_, GND)
R180 0R → +12V
x1,x2 R190 0R, 0R R680
49K9 R169, 10N C102, 10U C106
5K76 R163

POWER SUPPLY

+USUPPSW → Uin
REG_ON → ON/OFF Control
Uout 1 → +USUPPME
Uout 2 → +22.5V_M
Sheet 10/10

+5VSTB: R102 10K, 14 CD4013BCM Z5 (S VCC, C1, 1D, R GND)
+5V: 10K R50, LM339D V3
+5V: 0U1 C39, 0U1 C85
+5VSTB: 0U1 C72, 0U1 C52

Schutzvermerk nach DIN 34 beachten

Marquette Hellige GmbH D-79007 Freiburg	388 032 67-D09
Not equipped in Version : x1 388 032 67, x2 388 032 68, x3, x4, x5	Sheet: 9 of 10

REVISIONS					
Revision-No	Index	Date / Name	A03	F67252	
------	B	04.02.99/NTS		Date / Name	
ECO-062289	C	21.06.99/MSG	DRAWN	03.02.98/NTS	
ECO-063901	D	14.12.99/NTS	APPROVED	09.03.98/NTS	
ECO-062920	E	13.01.00/NTS			
ECO-067494	F	23.07.01/TYR	ISSUED	N. SCHNURR	

SCHEMATIC
STEUERUNG CS_CI

[1997, 8, 11, 2]
$USER_CAE_B/cardiosmart_ci/control_ci/design/power_supply

CONTROL(CO_E:0)

REG.ON

ON/OFF Control

Enable = High
Disable = Low

Output 1

Input

Output 2

+USUPPME

+USUPPSW

+22.5V_M

R88 49R9

R60 1M5

R117 0R033

43n L43

43n L40

47u L31

220U C79 X1,X2

4u7 C284

4u7 C286

0U1 C48

GND22V

f=200KHz

LTC1435CS

1	COSC	TG	16
2	RUN_SS	BOOST	15
3	ITH	SW	14
4	SFB	VIN	13
5	SGND	INTVCC	12
6	VOSENSE	BG	11
7	SENSE-	PGND	10
8	SENSE+	EXTVCC	9

X5

10P C68
47P C64
0U1 C59

33R2 R115

1n C279

T7 IRLR024

0U1 C67

BYM13-30 D17

2u2 C307 X1,X2

2u2 C44

MBRS360T3 D8

47u L21

0R033 R72

4u7 C43

4u7 C42

4u7 C285

0U1 C32

43n L20

43n L30

GNDITPC

4K75 R111

0U1 C63

2N2 C58

0U1 C62

1n C51

100p C54

4u7 C76

1R R92

2K21 R135

ZMM4.7 D79

1K R149

10N C278

3n3 C29

V2

IN+ IN- VCC GND PROG IOUT AVG SENSE

LT1620CS8

0U1 C30

22N C40

R705 100R

0U1 C38

R35 4K02

31K6 R707

R34 1M

100R R75

49R9 R66

0U1 C91

R165 475R

0U1 C99

R146 1M

LM358D

V8

100R R704

68K1 R697

1K R150

LM358D

V8

1K R158

3K16 R166

L12 43n

GND24V

GND22V

100p C31

R36 1K87

R37 33K2

PRINTER SUPPLY

Marquette Hellige GmbH D-79007 Freiburg						388 032 67-D10	Sheet: 10 of 10
Not equipped in Version :		REVISIONS Revision-No	Index	Date / Name	A03	F67252	
x1	388 032 67	------	A	14.09.98/NTS		Date / Name	
x2	388 032 68	ECO-062920	B	13.01.00/NTS	DRAWN	04.03.98/NTS	SCHEMATIC
x3		ECO-065096	C	30.11.00/MLB	APPROVED	08.03.98/NTS	STEUERUNG CS_CI
x4							
x5					ISSUED	N. SCHNURR	

Schutzvermerk nach DIN 34 beachten

[1998, 1, 26, 2]
$USER_CAE_B/cardiosmart_ci/control_ci/printer_supply

BT-AS: 0
BT-BS: 1376
LOET-AS: 315
LOET-BS: 4325

91541485

91541773

91541326

Code
44201010

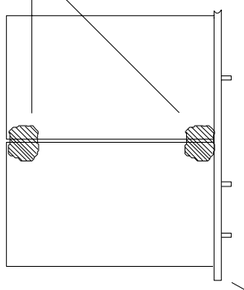
91541533

91541781

44200120

Code

glued on top
and bottom
oben und unten
geklebt



91541485

2/91541931

4/91541480

Code
4/44201005

92723057

BA1

do not remove
upper cover foil
obere Deckfolie
nicht entfernen

91542058

91541772

3/91618903

91542035

43252568

2x 80177736

tin-free
zinnfrei

2 fixations with
sealing glue
82907300

2x fixiert mit
Dichtungskleber
82907300

V16, V17, V18, V20 (14-pin)
placed in direction of pin 1
in Richtung Pin 1 platziert

43367252

92723057

WAVE
REFLOW

91542045

Schutzvermerk nach DIN 34 beachten.

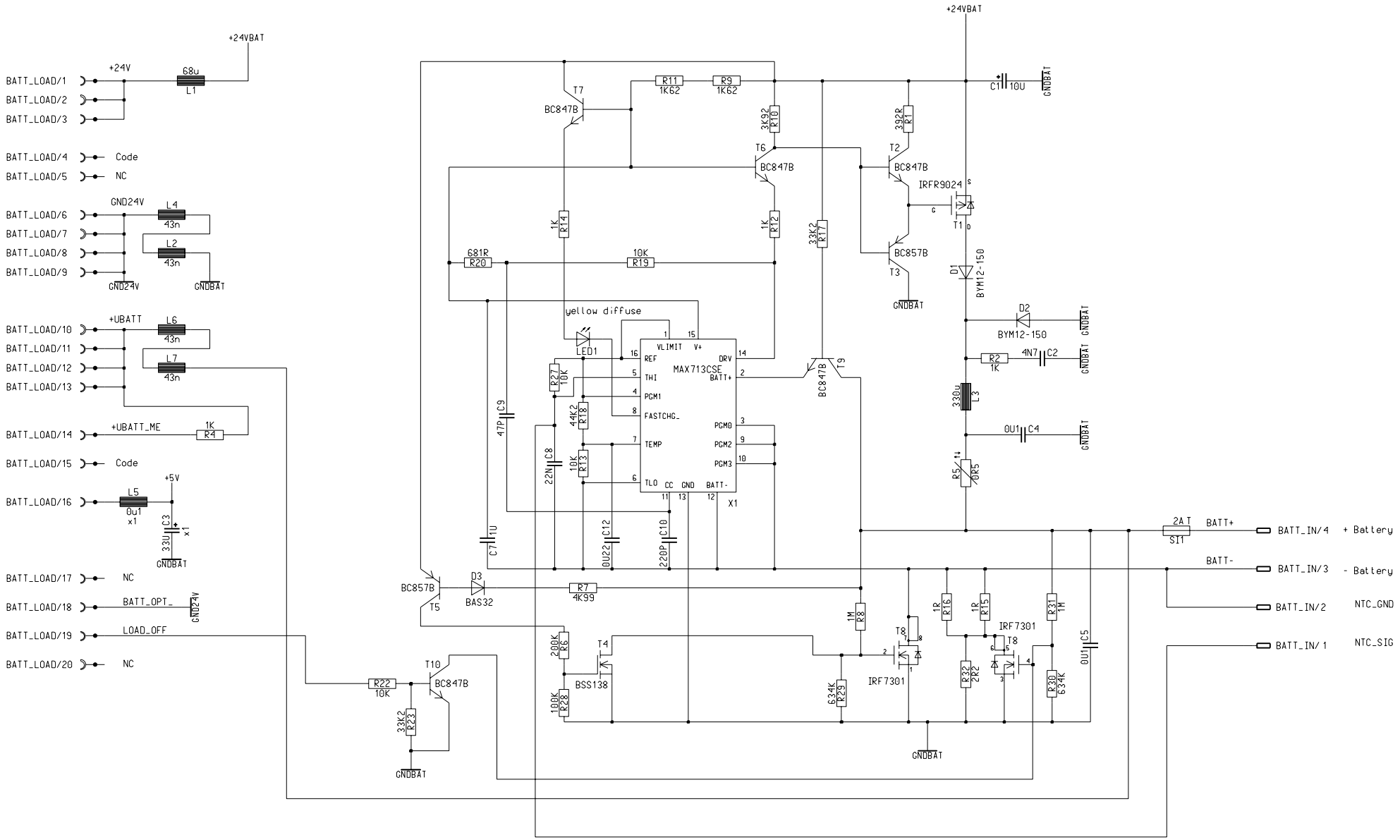
Marquette Hellige GmbH D-79007 Freiburg				38803267-D11 1 / 1	
REVISIONS				A03	
Revision-No	Index	Date/Name		43367252	
---	C	03.03.99/MSG		Date/Name	
ECO-062289	D	21.06.99/MSG	Drawn	09.03.98/MSG	REF DWG
ECO-063901	E	14.12.99/MSG	Approved	10.03.98/NTS	STEUERUNG CS_CI
ECO-062920	F	13.01.00/MSG			
ECO-065096	G	26.03.01/MSG	Issued	N.SCHNURR	

BT-AS: 0
BT-BS: 1376
LOET-AS: 315
LOET-BS: 4325

91541485
91541773
91541326
Code
44201010
91541533
91541781
44200120
Code
glued on top
and bottom
oben und unten
geklebt
TPC_DAT/
MOTOR/
HOS_BL/
POSUP/
BATT/
MO_SU/
RS232_E/
RS232/
tin-free
zinnfrei
two fixations with
sealing glue
82907300
2x fixiert mit
Dichtungskleber
82907300
91541772
HOS/
TPC_P0/
91541485
91541931
MR2/
MARK2/
2/91541480
Code
BDM/
4/44201005
JTAG/
92723057
ISP/
BA1
do not remove
upper cover foil
obere Deckfolie
nicht entfernen
43367252
92723057
WAVE
REFLOW
91542045
KEYB/
Code
3/91618903
91542035
43252568
2x 80177736
EKG/
Barcode
V16, V17, V18, V20 (14-pin)
placed in direction of pin 1
in Richtung Pin 1 bestuecken

Schutzvermerk nach DIN 34 beachten.

Marquette Hellige GmbH D-79007 Freiburg				38803268-D01 1 / 1
REVISIONS			AO3 43367252	REF DWG
Revision-No / Index / Date/Name			Date/Name	STEUERUNG CS_CI
--- / B / 02.03.99/MSG			
ECO-062289 / C / 21.06.99/MSG	Drawn	05.10.98/MSG	
ECO-063901 / D / 14.12.99/MSG	Approved	05.10.98/NTS	
ECO-062920 / E / 13.01.00/MSG			
ECO-065096 / F / 26.03.01/MSG	Issued	N. SCHNURR	



Schutzvermerk nach DIN 34 beachten

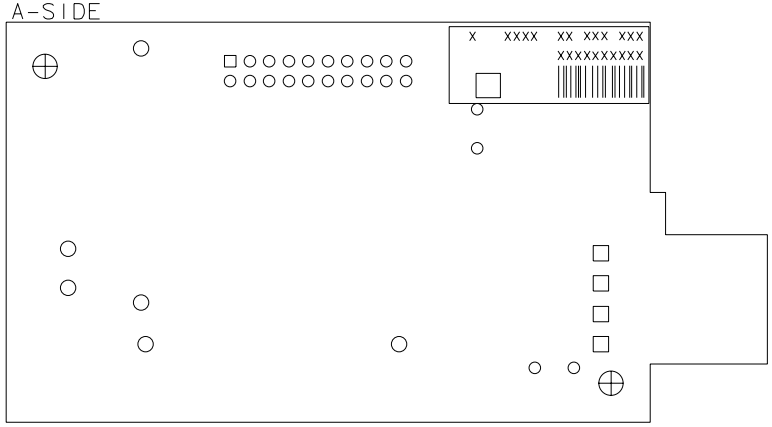
Marquette Hellige GmbH D-79007 Freiburg					388 032 90 - D01	Sheet: 1 of 1
Not equipped in Version :	REVISIONS			A03	F67267	
	Revision-No	Index	Date / Name		Date / Name	
x1 388 032 90	---	A	03.08.98 VRP			
x2	---	B	23.09.98 VRP	DRAWN	31.07.98/VRP	Schematic
x3	ECO-062727	C	24.06.99 HAW	APPROVED	31.07.98/NTS	
x4	ECO-062920	D	26.01.00 MSG			Akku-Ladung CS_CI
x5				ISSUED	N. Schnurr	

[1998, 3, 12, 5]
$USER_CAE_B/cardiosmart_ci/batload_ci/design

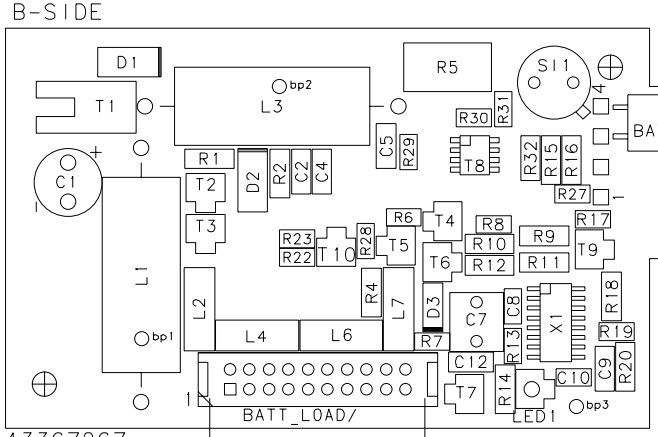
Schutzvermerk nach DIN 34 beachten.

BT-AS: 0
BT-BS: 53
LOET-AS: 34
LOET-BS: 114

A-SIDE



B-SIDE



91541690

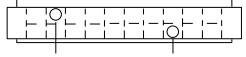
glued
geklebt

REFLOW

43367267

CABLE ASSY 38327394

WAVE

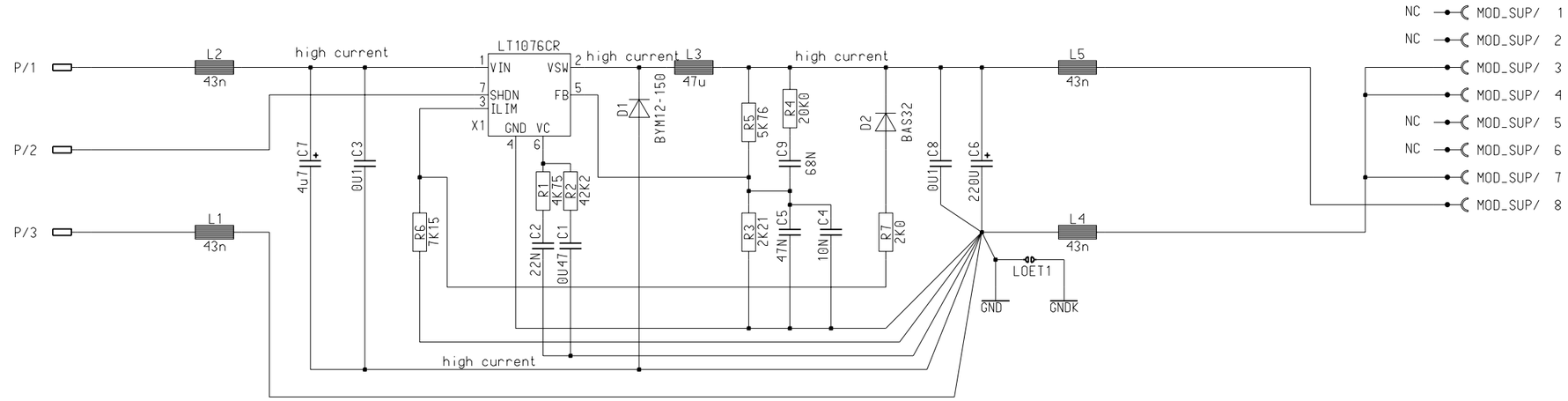


coded from bottom side
codiert auf Unterseite

Marquette Hellige GmbH D-79007 Freiburg				38803290-D02 1 / 1
REVISIONS				AO4 43367267
Revision-No	Index	Date/Name		Date/Name
----	A	03.08.98/MSG		
----	B	29.09.98/HAW	Drawn	17.04.98/MNS
062920	C	26.01.00/MSG	Approved	17.04.98/MSG
065708	D	30.10.00/MSG		
			Issued	M. Steinle

REF DWG

Akku-Ladung CS_CI

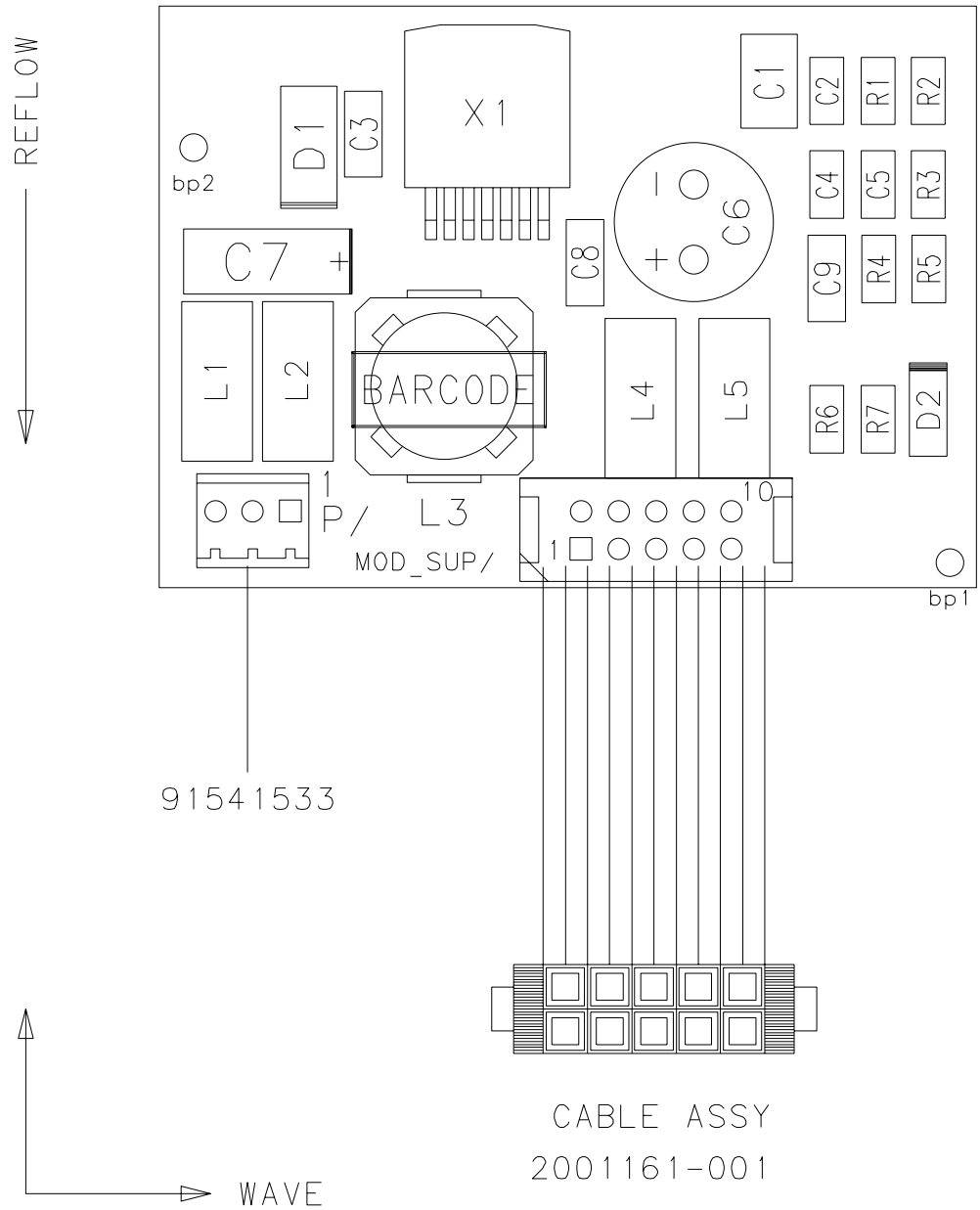


Schutzvermerk nach DIN 34 beachten

Marquette Hellige GmbH D-79007 Freiburg						2000772-001	Sheet: 1 of 01
Not equipped in Version :		REVISIONS Revision-No	Index	Date / Name	A03	2000770-001	
x1	2000771-001	ER20593	1	09.06.99/VRP		Date / Name	
x2		ER20816	2	20.07.99/HAW	DRAWN	09.06.99/VRP	SCHEMATIC
x3		062920	A	23.12.99/NTS	APPROVED	09.06.99/NTS	
x4		065687	B	18.10.00/MSG			MODEM SUPPLY CS_M
x5					ISSUED	V.PLACKE	

[1999, 6, 9, 4]
$USER_CAE_A/modem/design

BT-AS = 0
BT-BS = 27
Loet-AS = 15
Loet-BS = 53



Marquette Hellige GmbH D-79007 Freiburg				2000771-002 1 / 1
REVISIONS				A04
Revision-No	Index	Date/Name		2000770-001
ER20593	1	21.06.99/HAW		Date/Name
ER20816	2	20.07.99/HAW	Drawn	21.06.99/HAW
062920	A	12.01.00/MSG	Approved	21.06.99/MSG
065687	B	18.10.00/MSG		
			Issued	N.Weiss

DOC REF DWG
MODEM SUPPLY CS_M

Schutzvermerk nach DIN 34 beachten.

GE Medical Systems
Information Technologies

gemedicalsystems.com

European Headquarters
GE Medical Systems
Information Technologies GmbH
Postfach 60 02 65
D-79032 Freiburg • Germany
Tel. +49 761 45 43 - 0
Fax +49 761 45 43 - 233

World Headquarters
GE Medical Systems
Information Technologies, Inc.
8200 West Tower Avenue
Milwaukee, WI 53223 • USA
Tel. +1 414 355 5000
Fax +1 414 355 3790

Asia Pacific
GE Medical Systems Hong Kong Ltd.
11th Floor, The Lee Gardens
33 Hysan Avenue
Causeway Bay Hong Kong
Tel: +852.2100.6300
Fax: +852.2100.6292